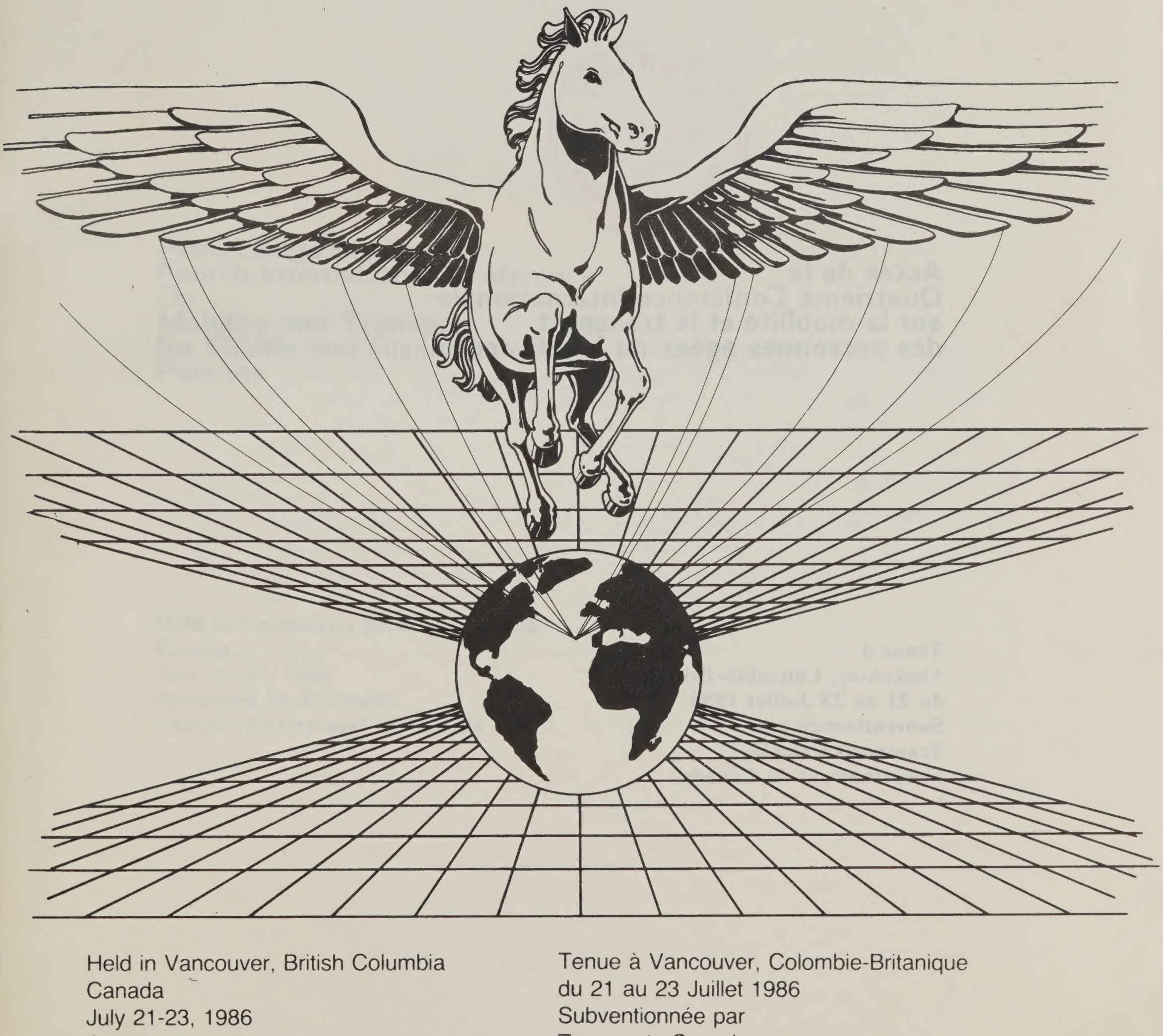
Proceedings of the Fourth International Conference On Mobility and Transport for Elderly and Disabled Persons

Actes de la Quatrième Conférence Internationale sur la mobilité et le transport des personnes âgées ou handicapées



Held in Vancouver, British Columbia
Canada
July 21-23, 1986
Sponsored by Transport
Canada, Government of Canada

Tenue à Vancouver, Colombie-Britanique
du 21 au 23 Juillet 1986
Subventionnée par
Transports Canada,
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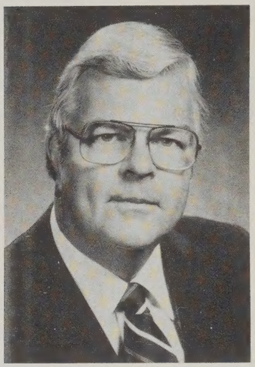
MESSAGE DU MINISTRE



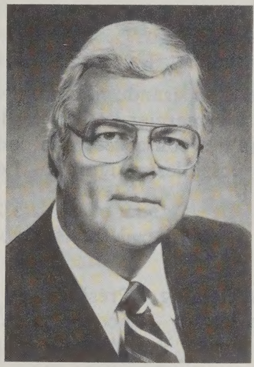
La quatrième conférence internationale sur la mobilité et le transports des personnes âgées et handicapées est soldée par un succès.

Transports Canada, en sa qualité d'hôte, en est fier. La conférence a réunui de 300 partipants venus de 15 nations, soit le plus grande nombre jamais vu. Pour la première fois, des fonds one été remis aux personnes handicappées pour leur permettre de s'inscrire à la confèrence. Quelque 50 personnes handicappées one donc pu y assister. De surcroît, une aire d'exposition officielle était fournie pour la première fois. Plus de 20 exposants, des quatre coins de monde, nous ont présenté leurs produits.

Le succès la conférence est attibuable en partie à la Urban Mass Transit Administration, du governement des Etats-Unis et aux provinces de l'Ontario et de la Colombie-Britanique. J'aimerais également soulingner la collaboration et l'appui de la Corporation EXPO 86. Nous sommes heureux que la conférence aid pu fiare partie de la semaine thématique EXPO 86. Nous sommes heureux que la conférence ait pu fiare partie de la semaine thématique d'EXPO 1986 sur les personnes handicappées.

J'espère que ce livret des délibérations vous servira de rappel de la conférence et qu'il sera aussi intéressant qu'instructif.

MESSAGE FROM THE MINISTER



As host of the Fourth Conference, Transport Canada is proud of the outcome. Over 300 delegates from 15 nations participated in the Conference events, the largest attendance to date. For the first time in this series of Conferences funds were awarded to disabled people to subsidize their Conference registration fee. As a result over 50 disabled people were present and made a significant contribution to the Conference sessions. In addition, for the first time there was a formal exhibit area. Over 20 exhibitors from around the world displayed their products.

Also contributing to the success of the Conference were the Urban Mass Transit Administration, Government of the United States; the Province of Ontario, and the Province of British Columbia. I would also like to thank the EXPO 86 Corporation for their co-operation and support. We are pleased that the Conference was part of EXPO 86's specialized period on disabled persons.

I hope that this book of proceedings will serve as a reminder of the Conference, and be both informative and interesting.

REMERCIEMENTS

Nous sommes redevables d'un grande nombre de personnes et d'organismes. Transports Canada tient à remercier le Comité de programme de la conférence pour les nombreuses heures qu'il a consacrées à la constitution de programme afin que les meilleures contributions possibles y figurent. Le Comité était formé des personnes suivantes:

Comité exécutif

Chris Fleming - Président de la conférence
Susan Barker - Vice-président de la conférence
Ling Suen - Président du programme

Comité de programme international

David Lewis - Coordonnateur du programme	Canada
Norman Ashford	Grande Bretagne
William Bell	Etats Unis
Stephen Blake	Etats Unis
André Leblanc	Canada
Pippa de Cosson	Etats Unis
Henry Enns	Canada
Ira Lastor	Etats Unis
Claes Eric Norrbom	Suède
Robert Paaswell	Etats Unis
Joseph Revis	Etats Unis
Arthur Salteman	Etats Unis
Dick Vogelzang	Hollande
Jill Weiss	Canada

Nous sommes également reconnaissants à ceux qui ont présenté de nouvelles technologies et de nouveaux services, dont bon nombre ont fait transporter à leurs frais de l'équipement lourd sur de longues distances.

Enfin, nous ne saurions passer sous silence la contribution du coordinateur du programme, le docteur David Lewis de la firme James F. Hickling Management Consultants Ltd. et de la coordonnatrice de la logistique, Mme Deborah Shnay, de Lemmex and Associates Ltd.

ACKNOWLEDGEMENTS

A great many individuals and organizations helped make the Conference a success. Transport Canada is grateful to the Conference Program Committee for the many hours that it spent in organizing the program to ensure that the best possible contributions were reflected. The Committee was made up of the following individuals:

Executive Committee

Chris Fleming - Conference Chair
Susan Barker - Conference Vice-Chair
Ling Suen - Program Chair

International Program Committee

David Lewis - Program Coordinator	Canada
Norman Ashford	United Kingdom
William Bell	United States
Stephen Blake	United States
André Leblanc	Canada
Pippa de Cosson	United States
Henry Enns	Canada
Ira Lastor	United States
Claes Eric Norrbom	Sweden
Robert Paaswell	United States
Joseph Revis	United States
Arthur Saltzman	United States
Dick Vogelzang	Netherlands
Jill Weiss	Canada

We are also indebted to those who exhibited new technologies and services at the Conference, many of whom needed to transport heavy equipment over great distances at their own expense. The exhibitors are listed at the end of this section.

Finally, we would like to acknowledge the contribution of the Program Co-ordinator Dr. David Lewis, of James F. Hickling Management Consultants Ltd., and the Logistics Co-ordinator Ms. Deborah Shnay of Lemmex and Associates Ltd.

PREFACE

Toute une série de thèmes et d'événements spéciaux étaient au programme de la quatrième conférence internationale, dont certains représentent une nouvelle orientation. Le programme de la confèrence compenait un débat organisé sur les questions controversées. Deux équipes, constituées chacune d'un avocat et d'un consommateur handicapé, ont débattu l'approche réglementaire ou non réglementaire de la mise en vigueur de la loi ayant trait aux voyageurs handicapés.

Autre précédent, toute une séance plénière a porté sur le rôle des techniques biomédicales dans la mobilité et le transport.

Des traditionnelles questions sur le transport en commun, des points tels les automobilistes âgés, la circulation des piétons, l'évaluation et la réadaptation des automobilistes handicapés et les questions intéressant les pays en voie de développement ont été traités. Les exposés figurent au présent volume.

La Suède sera l'hôte de la cinquième conférence internationale sur la mobilité et le transport des personnes âgées et handicapées en 1989. Le Canada est convaincu que les conférences continueront à connaître un succès retentissant.

PREFACE

A range of themes and special events were featured in the Fourth International Conference, some of which represent new departures in the field. The Conference program included an organized debate that provided a forum for the discussion of controversial issues of key concern in the field. Two teams, each including one lawyer and one disabled consumer, debated the issue of regulatory versus non-regulatory approaches to enforcing legislation for disabled travellers.

In another key departure, the role of bio-medical engineering in mobility and transportation was presented in one full Plenary session.

Together with traditional public transport issues, other key sessions covered the elderly driver, pedestrian traffic, disabled driver rehabilitation and assessment and issues in developing countries. The papers are presented in this volume.

The Fifth International Conference on Mobility and Transport for Elderly and Disabled Person will be held in 1989 in Sweden. Canada looks forward to the continued success of the Conference, in Sweden and beyond.

MATÉRIEL EXPOSÉ A L'INTÉRIEUR

Nom de l'exposant	Matériel exposé
The Handicycle	Fauteuil roulant avec freins de sécurité pour l'extérieur
Extensions for Independence	Démonstration du nouvel accès à l'indépendence offert par du matériel fonctionnel
E.L. Bryenton Associates Ltd.	Dispositif électronique compact pour malvoyants
Delta 7	Catamaran aménagé
Quintin Ehley	Fauteuil roulant à engrenages spécialement adapté
Boeing Commercial Airplane Comp.	Avion commercial aménagé pour les passagers handicapés
South Australian Department of Housing and Construction	Contact des personnes âgées et handicapées avec les constructions
G.F. Strong Rehabilitation Centre	Modèle d'evaluation informatisée des conducteurs handicapés
Venable Machinery	Appareil élévateur pour handicapés
The Smith-Kettlewell Eye Research Foundation	Aides matérielles pour aveugles
B.C. Transit	Projet témoin d'affectation et de courtage informatisés de Transports Canada et de la B.C. Transit (Vancouver)
Southern California Rapid Transit District	Services de transport en commun à itineraire libre et itinéraire fixe
Transport Canada	Commandes manuelles amovibles et dispositifs d'immobilisation de fauteuil roulant pour véhicules
Neil Squire Foundation	Robot facilement programmable à l'aide d'un ordinateur domestique
London Taxis' International	Taxi adapté aux handicapés
James F. Hickling Management Consultants Ltd.	Modèle informatique de gabarits de fauteuils roulants qui détermine s'il est possible de ranger ces fauteuils dans des voitures de tourisme
Canheart Industries Ltd.	Marchette pour personnes âgées et victimes d'apoplexie
Q'Straint	Systéme de fixation de fauteuil roulant avec retenue de l'occupant

INSIDE EXHIBITS

Exhibitor Name	Exhibit
The Handicycle	Outdoor wheelchair with safety brakes
Extensions for Independence	Demonstration of new avenues for independence using functional equipment
E.L. Bryenton Associates Ltd.	Compact electronic device for the visually impaired
Delta 7	Accessible catamaran
Quintin Ehley	Specially adapted geared wheelchair
Boeing Commercial Airplane Company	Commercial airplane made accessible for disabled Passengers
South Australian Department of Housing and Construction	Interface between aged and disabled persons with the built environment
G.F. Strong Rehabilitation Centre/U.B.C.	Computerized driver assessment model for disabled persons
Venable Machinery	Elevating device for the handicapped
The Smith-Kettlewell Eye Research Foundation	Assistance devices for the blind
B.C. Transit	Transport Canada/B.C. Transit Vancouver computerized scheduling and brokerage demonstration project
Southern California Rapid Transit District	Services provided for paratransit and fixed route transit
Transport Canada	Quick release hand controls and vehicle tie-downs
Neil Squire Foundation	Robot easily programmed by home computer
London Taxis' International	Taxi adapted for handicapped
James F. Hickling Management Consultants Limited	Wheelchair template computer model which predicts wheelchair storage capacity of private passenger vehicles
Canheart Industries Limited	Walker for elderly and stroke victims
Q'Straint	Wheelchair and occupant restraint system

MATÉRIEL EXPOSÉ A L'EXTÉRIEUR

Nom de l'exposant	Matériel exposé
Kingston Transfer Chair	Élévateur de gar routière
TES Limited et Motor	Accessobus, autocar aménagé
Coach Industries	
S.N.V., Allemagne de l'Ouest Neoplan Bus	Fourgonnette aménagée
Juré Limited	Fourgonnette aménagée
Care Concepts Inc.	Mini Fourgonnette

OUTSIDE EXHIBITS

Exhibitor Name	**Exhibit**
Kingston Transfer Chair	Station-based bus lift
TES Limited/Motor Coach Industries	Accessobus - accessible intercity bus
S.N.V., West Germany	Neoplan Bus - accessible van
Juré Limited	Accessible van
Care Concepts Inc.	Mini van

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SOME CROSS CULTURAL COMPARISONS

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SELECTED ISSUES IN SPECIALIZED TRANSPORTATION:

SOME CROSS CULTURAL COMPARISONS

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Norman J. Ashford, University of Technology, Loughborough, Leics.

Introduction

This overview presentation identifies and reviews differential approaches to a selected number of policy issues relevant to improving the mobility of disabled and elderly persons served by specialized transit services. The issues transcend the geographic borders of any single country hence are treated internationally. In highlighting the various approaches uncovered by the analyses, there is no suggestion that any single policy position is the "right" one. So much of the decision to pursue a specific policy, even one that may be shared by many countries, rests on cultural preferences, laws and customs germane to that country, hence is appropriate for that country and may possibly be equally appropriate for other countries with similar backgrounds.

The intent of this review, therefore, is not to be prescriptive or recommend the adoption of a single solution to any of the issues raised. Rather the intent is through review of different approaches currently pursued to illuminate potential alternative policy positions useful for consideration. This manuscript recognizes the opportunity for cross cultural exchange on the common issues, problems and practices which are germane to specialized transportation.

Specialized transportation is a relatively new and maturing sector of the general transportation network in a country. There is no universally acceptable term for the kind of service we have chosen to consider within this term.

A somewhat imprecise definition of specialized transportation suggests it is that form of transportation concerned with those groups in society whose normal mobility is impaired by an inability to make use, for many reasons, of the generic forms of transportation many able-bodied persons take for granted: walking, private automobiles, and public transportation services. We tend to highlight the elderly and the disabled as primary groups with special transit needs leaving undefined the range of disabled persons for whom specialized transportation services are designed.

Given the association of elderly persons with handicapped persons as targets of interest to this group, it may be useful to summarize some data on the size of the aging population in parts of the world. Universally, persons aged 65 years and over are becoming a substantial minority of their respective countries. According to the Population Reference Bureau, in 1985 some 6 per cent of the world were elderly, but in the more developed countries they constituted 12 per cent of the population. In Asia the figures range from 4 per cent in Korea to 10 per cent in Japan. In North America, Canada had 10 per cent while in the U.S. it is approaching 12 per cent. In Latin America the elderly total 5 per cent. Europe has the highest ratio of elderly, 13 per cent, ranging from 12 per cent in the Netherlands to 16 per cent in Sweden, soon to be 17 per cent. As a country Sweden has the highest proportion of its population aged 65 years and over. The vast majority of older people are not impaired and reside in a domiciliary setting; only about 4 per cent of the elderly reside in an institution at a given time. Most older people are female and the ratio of females to males increases as one goes up the age scale.

Comparable data on the disabled are not as easily available, in part because the term 'disabled' is variously defined and does not lend itself to simple counting of heads as is the case with data based on chronological age. Some estimates suggest about 5 per cent of the population are disabled, and approximately 30 - 40 per cent of the disabled may be elderly. These proportions may be higher in Europe.

The core generator of specialized transportation service, as in all transportation systems is mobility, or the capacity to move purposefully from one place to another. Transportation is a means of satisfying one's mobility requirements. Given the nature of growth and land use in most countries, walking inadequately satisfies one's mobility needs. Moreover, mobility is integral to supporting the social and economic integration of the elderly and disabled. Adequate transportation, at reasonable cost, is essential to enabling the transportation disadvantaged to achieve a measure of the benefits of society's social and economic opportunities. A number of policies bearing on specialized transportation are rooted in the principle of normalization. This principle holds that any disabled or disadvantaged person should be assisted to maintain a pattern of living and a lifestyle roughly approximating the norm within a given society.

We recognize and accept the fact that the private car is the salient and most popular form of transportation and is likely to remain so in the forseeable future. This preference holds true for handicapped persons as it does for the non-handicapped traveler. However, the high cost of car ownership supplemented

mobility needs of elderly and handicapped tend to be treated as if the two were a single constituency. In most developed or underdeveloped countries, the elderly and disabled are treated separately from the legislative viewpoint, though in some local services a single unit may serve both groups.

The roots of a dual emphasis on elderly and handicapped persons in the U.S. lies in the language of a series of substantive federal legislative measures beginning in 1970 with the widely cited amendment, 16(a), of the Urban Mass Transportation Act of 1964. The amendment was the first to introduce language declaring it to be national policy that federally funded mass transportation facilities and services receiving federal funds were required to meet the special needs of the elderly and the handicapped. Proponents of a national policy mandating improved transportation for both groups found it politically expedient to meld their interests in pressing for increased funding from national sources.

It should be noted that the U.S. is the only country with an Administration on Aging, or its counterpart, with policy and funding responsibilities at the national level. In most countries, consideration of social policy issues affecting older people is incorporated in a broadly based ministry of social welfare embracing all ages. One of the consequences of the American developments in transportation is that national policy and programme direction is shared by the national transportation agency and the federal human services network. Funds spent on specialized transportation in the U.S. by the latter far outstrip those spent by the U.S. DOT (Rosenbloom 1982; see also, Tolliver 1984).

In practice, in countries outside the U.S., the distinctions drawn between transport for older persons and disabled persons are not quite as neat as the foregoing description implies. Local transport services offered by public transit or privately operated transportation may be addressed to both communities, suggesting some parallel to the U.S. experience. Concessionary fares and other measures taken in Great Britain, for example, tend to blur the sharp distinction between the able-bodied and disabled elderly. This recognizes that some intact elderly are limited in their choice of transit modes by reason of their residence in households without a private car or by an inability to drive a car (Stahl, 1984); hence they are dependent on some local variation of door-to-door service offered by a community agency, or they satisfy their need for mobility as passengers in private cars owned by family or friends. One study in the U.S. points out that for most older people as for other ages, the preference is for trips by car, since only seven per cent of all trips by older persons in Los Angeles were made on public transit (Wachs, 1985).

by inherent deficiencies or lack of universally available public transportation, particularly in rural areas, has generated a demand for socially provided transportation alternatives to satisfy the mobility of transportation disadvantaged populations. Without a doubt the overwhelming proportion of all travel, regardless of one's disability, is by means of the private automobile; however the small market served by specialized transit is critical and merits its share of attention.

Fortunately there is a growing body of literature devoted to specialized transportation. The production of new material over the past decade has been substantial. What is satisfying as well to these authors is that the growth of literature from international sources is derived in major part from three earlier international conferences co-sponsored by our two universities. It is this and earlier conferences that help make it possible to undertake useful comparisons on similarities and differences on policy and operational issues of interest to policy specialists, decision makers, researchers and specialized transit providers.

Issue 1.

Linking the Mobility Requirement of Elderly and Handicapped Persons.

Since not all elderly are handicapped and not all handicapped are elderly, a basic issue of national policy and local service provision is the linking of these two groups as reflected in the title of this international conference.

The approach within the international field is mixed on this issue. The travel requirements of both groups may overlap to some degree but they are not necessarily congruent, given the heterogeneity of the aging and of the handicapped. Most countries give planning attention largely to integrating the travel requirements of the elderly with public systems, whereas in the United States the elderly are assigned a priority equivalent to the disabled on both public and specialized transit programs.

In European countries and Canada, as an example, the disabled are the primary group for whom specialized transit services are designed and operated. Age is irrelevant in qualifying for specialized services; specific conditions associated with disabled persons constitute the ticket of admission to the specialized vehicle. By contrast, in the U.S., local transportation services are expected to target both groups uniformly, addressing able-bodied as well as disabled older persons, regardless of whether the service is located in a public transit agency or a specialized provider. In the U.S. the

human services arena, policy on specialized services is based on two explicit but relatively untested assumptions: 1) lack of transportation is said to be a barrier to the use of social services essential to the well being of elderly and handicapped persons; and 2) increasing the availability and affordability of transportation for these two groups will increase the use of needed social services. The conflict arises in part from the policy orientation of the U.S. DOT programs and the differences in viewpoint on the responsibility of aided transportation programs in meeting the mobility needs of elderly and handicapped persons and the position taken by advocates for these groups.

In Great Britain, provision for improving the mobility of elderly and disabled persons is multifaceted in funding and is offered through three distinct sub-systems at the local level, with a discernable absence of coordination between the programs offered under different administrative auspices (Bell, 1983). These three are: specialized transit offered by voluntary organizations through community transport schemes; transportation provided by statutory authorities, including those sponsored by shire social service departments, and those offered by regional health authorities; and finally, the collaborative efforts in rural towns and villages, between the National Bus Company and local authorities.

In Sweden, after an initial experimental period where local fire departments provided specialized transport, largely on a volunteer basis under the auspices of the local authorities, transportation for the disabled is now regarded as a transportation issue not a social service issue. Since 1977 specialized transportation for handicapped persons qualifying for the service is administered by the public transportation body, where one exists (Berg and Christensson, 1982). Policy on entitlement is largely set by the County Council, to whom all public services are accountable, though the funding arrangements involve a mix of mandated funds from national and lower level jurisdictions. It is notable that the Swedish approach to specialized transport is directed exclusively to handicapped persons of all ages, and is publicly subsidized at an unusually high level of 90 - 95 per cent of the overall costs.

A second and related issue is whether the specialized service should be the responsibility of the public transit agency, where one exists, or assigned to a separate local specialized provider. This issue is controversial, and has been posed by some advocates for the handicapped in dichotomous terms as the alternative to "mainstreaming" as opposed to the alternative to a parallel special demand responsive system for use by handicapped persons (see Wallin, 1982). The position in support of mainstreaming advanced strongly by many in the handicapped community is that the formal transit agency should be the primary provider and held

Combining consideration of the elderly with the handicapped in transportation resources has both positive and negative effects. On the negative side many of the able-bodied elderly may resent the implication that mere age is a handicap. Others argue that chronological age by itself is no indicator of need and ought not to qualify a person for socially provided goods and services (Neugarten, 1982). Despite its negatives, the grouping of the elderly with the handicapped has had a positive outcome in the U.S., for it has resulted in more attention to the mobility needs of the aging than would otherwise be the case (Wachs, 1985). It may be easier for older persons in some countries to gain the policy attention of decision makers in a collaborative effort with the disabled rather than in competing with them. In underdeveloped countries, particularly where constrained resources are more starkly at stake, the hard choices forced on decision makers tend to favor the special transport needs of the disabled, regardless of age, as a primary focus.

Summarizing, on a cross cultural level, the respective approaches to merging or separating the mobility requirements of elderly persons and disabled persons, may be a function of innate policy preference, legislative rationality, or the comparative political power of older persons and disabled persons in that society.

Issue 2.

Locus of Policy Determination in Specialized Transit

There are perhaps two related issues of interest here. The first issue can be phrased as follows: should policy and funding for specialized transit at national (and lower) levels be the joint responsibility of the human service and the transportation systems or solely that of the transportation agency?

It is clear, as suggested in the prior section, that in the U.S., the policy posture of joint responsibility is pursued, in the light of the dual funding arrangements offered by the national human services network and by the federal transportation agency. This procedure conforms to what one observer of the national scene has characterized as the 'golden rule': "them that has the gold sets the rules".

Rosenbloom sees this mixed policy orientation in two distinct policy arenas as conflicting, complementary and at times ambiguous (Rosenbloom, 1982). It is ambiguous by reason of "an uneasy mixture of congressional mandate (not always clear and consistent), federal administrative rules and regulations ... other administrative actions and the responses of state and local governments ....". It is complementary, in the sense that in the

accountable for the transportation of handicapped people as it is for others requiring transportation. The fear articulated by advocates for disabled persons is that in a period of financial strain parallel services are more easily abolished or curtailed whereas funds for public transportation are somewhat more stable.

In general, in the U.S. and Great Britain the tendency is to establish specialized services under voluntary auspices but there are a number of public transport authorities which incorporate a specialized service. There are an estimated 4,000 - 5,000 special transportation units in the U.S., stimulated and funded in major part by provisions of the Older Americans Act, administered largely by private non-profit making organizations. However, urban transit authorities, like the Washington Metropolitan Area Transit Authority, include a unit of specialized service named 'On-Call', for handicapped persons in order to conform with federal regulations.

In Europe there is a different approach from country to country. For example, Sweden, as exemplified by the SL system operating in Stockholm, represents a public transit authority solution, one that is all inclusive and heavily centralized. The Berlin Telebus is a mainframe computer controlled dial-a-ride transit authority operated system, exemplifying the total design and operator solution.

In Germany and Holland, the overall strategy is established by public transit authorities but actual operations are carried out by local agencies or authorities. A similar approach is found in Great Britain, where the London Regional Transport (LRT) has responsibility for the London area Dial-A-Ride under the general direction of the central government. Generally, in the United Kingdom, specialized transport has been kept separate from the public transportation provider, as suggested earlier. The rationale behind this position is to avoid subsuming the problem of specialized transport into the much larger and potentially overwhelming problem of providing general public transport. In many cases the day-to-day operation of the specialized system may be delegated to a transport unit where policy is independently or jointly determined.

Issue 3.

Should all existing public transit systems be retrofitted to provide universal accessibility or should parallel specialized transit systems be developed to provide for the needs of disabled persons?

This is an extremely contentious issue and is related to Issue 5, to which we will return later. Most purists propose, but without

elaboration, that the entire transport system must be adapted to the needs of the disabled and argue that public transit providers must be made responsible for the handicapped as much as for others (Brattgard, 1978). It would appear that the national end view is materially affected by national concepts of human rights. In countries such as the United States, Canada (Baker, 1984) and increasingly France (Artaud-Macari, 1978), there is a substantial view that universal accessibility is a human right. With such beliefs, the problem of cost effectiveness can be ignored, and the matter must be resolved as a civil rights issue. There is also a measure of pragmatic support for this view based on the argument that parallel systems are vulnerable in times of financial constraint and do not therefore represent a reasonable long term solution. Seen simply in terms of civil rights, even one person using a system, regardless of costs justifies making the public transit system accessible.

Others recommend approaching the problem from the viewpoint of cost-effectiveness, even though this may not lead to a fully accessible system. To many the objective of fully accessible systems is illusory, due to the many problems of access outside the ambit of the transit system or to the problems of cost. In countries such as the United Kingdom, Holland and Sweden, the approach seems to favour a reasonable right to mobility, providing this in the most most effective manner.

The Washington Metropolitan Area Transit Authority (WMATA) in Washington D.C. has arrived at an interesting solution to the above issue which is somewhat of a compromise. The previously cited **On-Call Service**, established in 1982, enables a handicapped person in a wheelchair to call the WMATA system 24 hours ahead of a projected trip and to have a lift equipped bus inserted in the scheduled fixed route to arrive at the appropriate bus stop at a designated time to pick up the disabled passenger along with other passengers. About 15 per cent of the WMATA buses are equipped in this way with more planned. The system is working well with ridership increasing each year. The handicapped person pays the reduced fare for disabled persons and the plan is considered by WMATA as the most cost-effective. Because it encourages a punctual response from the rider, the system is able to respond appropriately without vast expenditures. It has been found that in inclement weather, wheelchair users generally stay at home, but then so do other riders. The model has been picked up by Baltimore, and both Dallas and Boston are considering it. Perhaps even more remarkable is the fact that this model has also been assumed in a small British university town in 1986. Leicestershire, one of the rural shire counties of England, has decided to run about 10 per cent of its buses in Loughborough in a similar fashion.

Where fully accessible rapid transit systems have been provided,

such as BART in San Francisco and WMARTA in Washington D.C., critics have noted the low ridership achieved and the high cost. Some new European systems have been made fully accessible at a more reasonable cost, e.g. Tyne and Wear in England, but ridership is still very low. Estimates for making the German rail systems accessible have been found to be extremely high (Leimbach, 1984).

It is generally accepted that retrofitting the oldest rapid transit systems in cities such as Paris, London, Madrid and New York, viewed realistically,is impossibly expensive. Posed also as "mainstreaming vs. specialized transport", this has become for many in the United States an emotive issue. In the Second International Conference, Wallin presented an extremely useful analysis on mainstreaming (Wallin, 1982). He argued for a less emotional and more balanced approach in the light of the high costs involved. While acknowledging the difficulty of calculating the benefits involved in full accessibility, the results do not appear to measure up to the claimed benefits:

- expanded quality of service for the handicapped
- reduced demand for specialized social services
- benefits of conscience due to social equity
- benefits of productivity to the economy
- operating cost savings in transit operation.

Wallin proposed a "balanced" approach in Syracuse using a demand responsive Call-a-Bus system as an alternative to mainstreaming.

If local communities, rather than transit authorities, are to be required to develop parallel services this may involve, as in Britain, public, public-service and voluntary organizations which must be seen to have a permanent role in this area. Parallel services are likely to be best produced by coordinating the experience of medical, recreational and other activity groups as has been achieved by the East Sussex (ESCORT) scheme. National policy should encourage local coordination and indeed may require it if central government funds are involved.

Recent regulations in the United States persuant to Section 5.04 of the Rehabilitation Act of 1973 and Section 317(d) of the Surface Transportation Assistance Act of 1982 have set guidelines which clarify court decisions which have ruled that in prohibiting discrimination against the handicapped, the Federal government may not impose undue financial burdens on the recipients of Federal assistance (Federal Register 1986). Under the rule, each locality may choose the type of service it wants

to provide to meet regulatory requirements and specifically does not require existing inaccessible rail systems to be made accessible. While setting six service criteria which guarantee equality of service for the disabled, it limits the required expenditures to three per cent of operating costs.

Issue 4.

Adapting private automobiles vs. retrofitting public transport and providing specialized systems.

The private automobile is the preferred mode of transport generally in the United States and remains so for at least 80 per cent of the elderly; the reasons are its convenience and flexibility. Cost is, however, an inhibiting factor. Modifying private automobiles or purchasing specially designed vans for the handicapped, developing transfer devices and hand controls are all possibilities if money is available to undertake this type of purchase.

Surprisingly, most of the U.S. effort has been on the socially provided transport services for the handicapped and very little attention has been given to the problem of modifying the private automobile or to providing for its purchase in a way that has been achieved in Europe. In 1979 Lewis produced a report for the Congressional Budget Office comparing the effectiveness and costs of giving a capital grant to paraplegics and quadraplegics to cover the price of adapted motor vehicles with Section 5.04 solutions (Congressional Budget Office, 1979). The results were encouraging for the provision of automobile-based mobility but the proposal has, curiously in our opinion, generated little response.

In direct contrast, in the United Kingdom there is a now long established tradition of subsidy in this area. Starting after World War II with the provision of motorized "invalid tricycle" vehicles, the scheme has developed into the provision of a mobility allowance which assists disabled individuals to buy a motor vehicle. Permitting the maximum exercise of choice for those able to make use of the scheme, the mobility allowance has resulted in very strong support of the adapted personal private car. This has become increasingly financially feasible through additional supportive schemes such as MOTOBILITY which seeks to maximize the buying power of the mobility allowance in the car market.

There are considerable and strong arguments in support of the adapted private car:

1. The choice of mode of the disabled is more closely

aligned with the modal choice of the able bodied. The choice of destinations and therefore activities are therefore not significantly different. This can ensure a much closer integration of the disabled into the normal activities of society.

2. The disabled person is neither limited in his activities to those which are within reach of the public transport network nor inconvenienced by the limited service availability of door-to-door specialized services.

In most of Western Europe, retrofitting is not seen as a viable solution because:

1. The opportunity cost of the required technology is high.

2. The costs imposed on marginally viable transport systems may mean the loss of public transport for the whole community (the new Section 5.04 regulations in the United States recognize this danger).

3. In most cases the retrofitted vehicles operate to trip patterns which do not adequately serve the trip patterns of the disabled traveller; e.g. transit usually serves the radial trip well, but the off-centre trip poorly.

4. Retrofitted vehicles do not solve the door-to-vehicle access problem which is more amenable to solution by personal mobility provision (the car), or by specialized systems.

5. Experience with retrofitted systems indicates that they are simply incapable of generating a demand level which can be considered an acceptable solution to the problem.

Issue 5.

Total vs. partial system refitting.

As indicated in discussion of Issue 3, this too is contentious. Advocates of the partial system approach point to the very high opportunity costs associated with total retrofit and state that total system accessibility must be recognized as having a high marginal cost for a very small marginal market. Proponents of full system accessibility such as Brattgard of Sweden, insist that it is essential that not only the vehicles as such, but also

the entire transport system must be adapted to the needs of the disabled (Brattgard, 1978). Speaking of national policy in France, Artaud-Macari indicated in the First International Conference that Article 49 of the 1975 Orientation of the Handicapped Act implies an aim of full accessibility of all public systems, by reason of the philosophy that public transit must serve the social integration of the handicapped into society, (Artaud-Macari, 1978). A Canadian paper in the Third Conference, addressed the legal rights of the handicapped, making a strong case that the public carrier has the responsibility to ensure the given mode is accessible to disabled persons (Baker, 1984). While not speaking directly to the issue of full system accessibility, Baker suggests that all units of a given system must be accessible to the individual in a wheelchair or to those otherwise disabled.

As we, at this Fourth Conference in 1986, review progress by looking back to developments since the First Conference in 1984, it is clear that partial system adaptation appears to be winning the day. In Sweden, France and Britain the existing public transit systems in urban areas function much as before with only minor modifications to assist the handicapped. Specialized services are used to supplement the standard vehicles in the system. Retrofitting of intercity rail vehicles has occurred but the platforms remain a problem and *ad hoc* unsatisfactory solutions abound. In Issue 10 the progress on air transport will be discussed. Existing rapid rail systems have been regarded as unrefittable (Benwell, 1982).

The very low usage of transit systems by wheelchair passengers is a chronic condition confronting those advocates for the handicapped who either persuade or force the public transit system toward full accessibility. Partial system accessibility has the advantage that for a relatively small cost the system can provide for the needs of most of the handicapped and for all those elderly who are not handicapped. Where total accessibility has been provided, ridership from the handicapped community fails to achieve the planned levels of demand. Demand usually fails to materialize due to problems between the point of origin or destination and the service itself: inclement weather, inadequate sidewalks, unsuitable terrain, unacceptable waiting time, unacceptable distances to the service. All these problems argue for partial refitting supplemented by specialized systems.

Where accessible services have been provided, costs have been found to be high and ridership low (Multisystems Inc., 1983). For example, the COTRAN accessible service demonstration in Palm Beach showed that the number of lift boardings never exceeded 150 in one month and throughout the life of the project it was found that most of the trips were made by under twenty individuals. Estimates of trip costs for lift users have been quoted as

ranging from $8.30 in Seattle to an astonishing $227 in Washington D.C. Because of the low ridership and high costs per trip in Palm Beach ($56), COTRAN management recommends door-to-door service for the country's disabled persons at the end of the demonstration.

Almost as an aside, it is worth noting here that demonstration projects suffer from the fact that they are not seen by potential users as being open ended. Users are unlikely to make long term decisions, such as abandoning well established modes of travel (self-drive car, arranged lifts, taxi, etc.) for a service which is transitory in nature where factors such as routing, fare and frequency may be varied for experimental purposes. Under these conditions, the service may attract only those having no access to an automobile, having low incomes and living alone (Multisystems Inc., 1983).

Issue 6.

The prospect of user-side subsidies emerging as a national policy.

The concept of user-side subsidy (U-SS) has been tested on a limited basis in the United States and has emerged in Great Britain in the form of mobility allowances for disabled persons.

U-SS is an attractive economic concept, for it implies a latitude of consumer choices and stimulates supply-side competition among providers serving travellers with special needs. User-side subsidies distribute travel funds or grants to qualified users who then select among participating services for their local travel needs. The advantage of this approach most often cited is that it constitutes "instant specialized transportation service" by making use of existing services, thereby avoiding the necessity of initiating duplicative or perhaps costly new services, and it is administratively manageable. Obviously US-S is inappropriate as a service strategy in areas where an inappropriate service exists or existing transportation resources are not designed for those with special needs.

Spear has synthesized the findings from some eight local demonstrations in the United States financed by UMTA in the period 1976-1980 (Spear, 1982). He claims that of the eight, only one community chose not to continue some form of the demonstration program on expiration of the grant. The advantages, he suggests, are: the low cost per trip compared to travel costs of traditional publicy supported programs; the reduction of travel costs for those who otherwise would have had to pay the full fee, which they could ill afford; it is administratively controllable by imposing limits on the number of

permitted trips made available to users; and it is relatively free of fraud. In short, says Spear, U-SS program is adaptable to most local conditions for it can be implemented without major disruptions of local ordinances, fare structure or operating practices.

One inherent deterrent to the acceptability of U-SS, which may be viewed differently in different countries, is that it is a form of public assistance, carrying with it the stigma of "welfare". This may be more significant in the U.S. than it is in Europe or Canada. One of the earliest user-side subsidies was the mobility allowance for disabled persons in the United Kingdom; another was the introduction of concessionary fares for the elderly.

A variation of the mobility allowance or user-side subsidy, in Britain, was the provision of motorized tricycles to the handicapped, and the financing of cars with adapted controls for the disabled.

The mobility allowance experience in England gives no indication that user-side subsidies generate special services. Mobility grants in the United Kingdom did not have this effect because the recipient is not constrained to use the grant for transport services. It is, in fact, hard to argue that the use of the mobility allowance should be so constrained. Other legitimate alternative uses could include, for example, payments to surrogate shoppers and increased use of the telephone to compensate for travel.

A good illustration of the effect of supply side subsidy in conjunction with the user-side mobility allowance was the Greater London Council (GLC) taxi scheme which subsidized taxi trips up to a fare of £6.00 (about $8.00) leaving the rider to pay a flat fare of £1.00. The elimination of the GLC has led to the Taxicard, now the responsibility of London Regional Transport (LRT) and the individual London boroughs.

While the concept of user-side subsidy, as a broad-based approach to subsidizing travel for elderly and handicapped has not made any substantial inroads in national policy, the concept has gained favour in several countries as a taxi based system. In Canada, for example, the city of Calgary has experimented successfully with a taxi service employing user-side subsidy as an attractive and cost effective method of service for the elderly and handicapped market (Colquhoun and Bolger, 1984). Similarly, Stockholm's specialized service for the disabled includes the option of participants hailing a commercial taxi, paying only the current bus fare with the remainder of the fare subsidized by the Greater Stockholm Public Transport, sponsors of the county's special purpose transportation scheme (Bell and Bell, 1979).

In summary, the utility of the user-side subsidy has been demonstrated as locally attractive and lends itself particularly to the integration of existing cooperative taxi service for demand response purposes. The concept has not caught fire on a national level in any country, and seems likely it will remain a local rather than a national policy alternative.

Issue 7.

Use of coordination or market forces to structure local specialized services.

Coordination, the process of integrating two or more specialized transportation services to accomplish jointly the mutual ends of participating units, has for some time had an intuitive appeal for planners and policy makers, particularly in the U.S. and Britain in the late 1970s and early 1980s (Burkhardt, 1980; Busko and Saltzman, 1982; Lightfoot, 1982; Rosenbloom, 1982). In the U.S., for example, the term became a watchword in the literature and was incorporated, with limited evidence of its utility, in Congressional mandates. Given the multiple sources of funding for social service-oriented trips, local communities in the U.S. generated an unstructured, sometimes overlapping, roster of local specialized services in response to the multiple travel requirements of the disabled and the aging. Some of the 114 federally funded transportation programs are highly categorical, requiring sponsors to serve a designated narrow clientele, providing the rationale for local coordination (U.S. Comptroller General, 1977).

Burkhardt, one of the few to undertake a systematic analysis of coordination in the field, after studying the progress of five coordination specific projects, between 1977 and 1980, reported:

> Coordination has often been proposed as a means of eliminating duplication and waste, saving money, serving unserved groups, and expanding services. Statutory and regulatory obstacles to coordinating agency transportation systems exist ... they can be surmounted, but the coordination process is more costly, complex and time consuming than had been imagined. The intended benefits of coordination will probably be achieved only if certain preconditions are met and if precise coordination strategies are followed (Burkhardt, 1980).

As we indicated in 1982, out of this kind of probing inquiry has come a challenge to the widely accepted principle that coordination is a desirable arrangement in all situations. These

systematic efforts have directed attention to a new question vis-a-vis coordination. Rather than asking what are the barriers to coordination and how to overcome the resistance, they (planners and others) now ask: under what conditions and what aspects of specialized transportation are the costs of coordination justified by the actual benefits accruing to clients served by specialized transportation programs? (Ashford, Bell and Rich, 1982, p. 335).

The concept of coordination has lost its early appeal in the U.S. as new information and the reality of budget constraints have imposed a brake on new or expanding specialized local transport services. On the one hand, planners and policy specialists continue to propose coordination as an integrative strategy, while on the other hand, service providers argue that existing budgets and resources are inadequate to meet current, let alone rising, levels of responsibility for the handicapped and the elderly.

In essence, the criticism of coordination that has emerged suggests it is another illustration of marginal utility in local specialized transit services. It is intuitively attractive as a concept but both difficult and expensive to put into practice.

However, it has been argued that market forces in Europe have been ineffective in providing an economic solution to the provision of specialized services, to achieve more uniform coverage, a more satisfactory level of service, and a sensible policy of equipment usage. Some measure of social equity requires a significant movement away from dependence on market forces and much more use of local authority empowerment.

One illustration of the drive for local empowerment comes interestingly from the U.S. rather than Europe. At least eleven states, including Florida and New York, have passed state laws mandating some form of local coordination of systems for elderly and handicapped persons. For example, in 1979, the state legislature in Florida passed an act mandating a single coordinated transportation provider be designated to serve the transportation disadvantaged in each of the state's 67 counties. In 1986, some seven years since passage of the act, only 85 per cent of the counties in Florida have complied with the law. This suggests that even where there are strong regulations, incumbent on local government to follow, coordination is difficult to enforce, though it is expected that in time all 67 of Florida's counties will be in compliance.

Issue 8.

Providing specialized transport to community services versus relocating these services closer to the constituency served.

As yet the policy of balkanizing rather than centralizing services has not received a great deal of attention. Those proposing this indicate that any loss of facility efficiency is substantiated by transport savings, increased convenience and the advantages of local control. In general, in the western world, there is a continuing tendency to the abandoning of local facilities (e.g. cottage hospitals, local clinics, isolated physicians' offices, local shopping) in favour of larger regional or centralized facilities.

A number of papers at the First International Conference touched on this. It was indicated that in Belgium the government was examining policies which eliminated some of the demand for mobility by promoting the use of telephones and mobile shops (Harboort, 1978). In France, a careful examination of the mobility patterns of the elderly indicated that as people age their mobility centres around neighbourhood activities (Matelon and Averous, 1978). Hillman pointed out that there is a very real danger that the introduction of measures to improve the quality of public transport, the extension of the mobility allowance, combined with contemporary planning practices of effectively establishing facilities further away from the people they serve can create the conditions in which **local** facilities and services are allowed to decline (Hillman, 1978). Such ideas, combined with a realization in the 1980s, that centralization does not always bring about economies of scale due to unforeseen institutional problems, means that many are now beginning to question some of the former "truths" of centralization. This issue must open up the prospect of an alternative to accept the provision of social transportation and social services as currently given. Are there not other ways societies ought to deal with the manner in which people are linked to essential services if, as is argued, transportation is the essential linkage between older people and their access to major (or even life sustaining) services?

Obviously in many countries, certain facilities, like regional hospitals, must be provided on a scattered basis. But these are necessary only for specialized treatment. Satellite health programmes, clinics and day centres could be brought into closer proximity to the people. Mobile clinics, shops and other services can reduce the need to travel. Finally, the effect of regionalization at the expense of the neighbourhood can cause

severe inconvenience to the reasonably mobile elderly pedestrian who constitutes the majority of elderly people. In the U.S., for example, about 4 per cent of the elderly are housebound. The vast majority are mobile pedestrians, but their walking capabilities are limited. Overconcentration on providing some form of transit or specialized transport for "the-elderly-and-handicapped" tends to forget the needs of this substantial group of pedestrians. The elderly pedestrian may be a newcomer to the mode by reason of giving up the car due to lowered income or due to disinclination to drive or disabilities. For the healthy elderly person, the walk trip is welcome and desirable exercise and recreation, provided the distances are kept within capabilities. Far too little work by urban and transport planners has examined the desirability of designing an urban or suburban environment attuned to the need of the pedestrian.

Issue 9.

A broad versus a narrow definition of eligibility for specialized services.

It is not surprising that on an international level the vast majority of specialized transportation services are addressed to disabled persons, particularly persons with physical disabilities inhibiting or preventing their use of traditional forms of public and private transportation methods to satisfy their normal demands for mobility. What is surprising is the sparse attention in the literature to a clearer definition of disabled persons entitled to consideration in the use of specialized transportation resources.

The issue here is whether there ought to be a broad or a narrow definition of disabilities in qualifying for eligibility for specialized transit, and should the decision be unique to each system or can there be some concurrence in the field on the parameters of the target groups?

Currently the criteria for inclusion in specific specialized transit services are different and unique to each service. Perhaps they ought to remain that way. Most specialized services tend to ignore age as a factor for entitlement but the other specific disabilities qualifying one for service vary widely. Sweden favours the individual approach, leaving the selection of criteria to each county (Berg and Christensson, 1982). It is likely, for example, that the impaired using the special system in Brussels will differ from those using Stockholm's system. The Brussels system is addressed to two sub-populations: the blind with a visual disability of 90 per cent, and severely handicapped persons without complete and definitive use of two upper or lower limbs (Harboort, 1982). The criteria used in the Stockholm

system are broader than Brussels for the former does serve the mentally retarded (Bell and Bell, 1979).

It appears that the handicapped community of major interest to planners of specialized transportation are the physically impaired, particularly those requiring use of a wheelchair, and the legally blind. In some systems like Stockholm the mentally deficient, who are not to be confused with the mentally ill, are included as is the case of the provincial system in Quebec, Canada (Forcier, 1984).

The landmark case in Canada affirming the travel rights of the disabled, Kelly vs. VIA Rail, Canada (1980), was based on an individual in a wheelchair unable to gain access to a commuter train without assistance (Baker, 1984). What is not clear is the extent to which the favourable ruling in the Kelly case applies to persons with other disabling conditions or whether it is confined solely to disabled persons requiring an attendant for travel purposes.

In a similar vein, the Report of the Special Committee on the Disabled and the Handicapped (Obstacles, 1981) calls for amending the Canadian Human Rights Act to embrace a new and broader definition of mental and physical handicaps as proscribed grounds of discrimination under the Act. However, in the Report's section on transportation, no equivalent identification and definition of disabled persons is included.

The British Department of Transport recently published an exhaustive guide bringing together essential basic information on transport for disabled people but confines its consideration to the blind and the partially sighted, along with the physically handicapped, without further elaboration of other forms of travel disabilities (Department of Transport, 1982). This oversight may change in the near future. A Select Committee of the British House of Commons has been examining the problems of transport for a broad range of the disabled including the mentally and financially disabled.

Unlike planners and others in the field of international air travel who have exhibited concern about the absence of universally accepted accessibility standards for disabled persons, the field of specialized transit has not identified the matter of defining the target population of disabled persons as a priority issue. Nevertheless, the principle of equity with respect to access to specialized transportation services suggests the range of disabilities entitling one to the growing network of specialized transportation resources may need to be addressed in the near future.

Issue 10.

Air travel and operational practices of air carriers.

The increasing demand for air transport as the cost of air travel continues to decline in real terms means that more of the general population and more elderly persons wish to travel by this mode. Other factors reinforcing this trend are the higher proportion of the elderly in the population and increased incomes on retirement. Consequently, there are very high increases in air travel by partially and fully disabled persons.

Access for the disabled within the airport terminal itself is generally reasonably good for the handicapped traveller (Matson, 1984). This is no doubt due to the fact that even if not disabled, a large proportion of the population is badly encumbered by baggage and paraphernalia. Air terminal designers in coping with baggage and baggage trolleys have been able to provide a reasonably friendly environment for the disabled. The tradition that air travel is a premium mode of travel has also ensured that airline ground staff have been available to ease the disabled or elderly traveller through the terminal when necessary.

In the past the principal problems have occurred in association with the air vehicle itself, especially with respect to those who are wheelchair bound. Fortunately, general improvements in the design of the air vehicle have made it easier to accommodate the handicapped in terms of access and mobility within the cabin and to provide access to toilet facilities. With the advent of wide-bodied aircraft, wider aisles and accessible toilets have been made possible. On-board wheelchairs which are accessible to the aisles and permit easier use of toilets are now available, although not yet universally so, even with the long haul carriers (Gronow, 1984). Deregulation in the U.S. has not been a constructive development as far as the handicapped are concerned. On some non-hub routes, small commuter aircraft have replaced conventional jets; this can impose severe difficulties which are not encountered on the more spacious conventional and wide-body jets.

Major problems occur with differences in operational practices between airlines. Theoretically a captain has the right to refuse to carry any person whose physical condition may endanger the flight (Sack and Shaver, 1978). In the past, this rule appears to have been applied capriciously, with the result that a journey once started may not be easily completed if a change of airline is involved. Some airlines now issue cards which indicate that certain passengers with a chronic disability require no medical clearance. Wheelchair passengers are classified according to the degree of assistance needed to board

the aircraft and gain access to the seat (Dunlop, 1984). This type of documentation not only ensures that boarding assistance is available as necessary but also helps to avoid the situation where a traveller is needlessly denied carriage.

Carriage of the wheelchair itself creates a problem. Damage to the wheelchair during carriage must be avoided; it is potentially much more serious than damage to ordinary passenger baggage. But it is difficult to ensure that no damage occurs when the wheelchair is placed in the hold and is treated with out-of-gauge baggage. Alternatively, it is difficult from the space viewpoint to carry chairs within the cabin itself. Further problems arise with the carriage of batteries for wheelchairs; these must be regarded as dangerous goods when carried by air, requiring special handling.

Finally, the carriage of a disabled person may involve a higher element of risk where evacuation in case of an emergency occurs. Ideally, a passenger cabin can be evacuated in 90 seconds. Placing a disabled person by an emergency door to ensure that passenger a high probability of escape may endanger the lives of others; placing the passenger in a position to be last out of an exit will ensure the exit will not be unnecessarily blocked, but may endanger the passenger.

The FAA itself has no policy on handicapped travellers, however, the agency requires each airline to have a specified policy on arrangements for handicapped travellers while not specifying in any way what that policy should be.

On 27 June 1986 the US Supreme Court ruled by a vote of 6 to 3 that commercial airplanes are not subject to provision of Section 5.04 of the 1973 Rehabilitation Act. In their decision the Court struck down a decision by the Appeals Court that required the US DOT to draw up rules protecting the rights of handicapped travellers. The Reagan administration challenged the Appeals Court ruling, and were in fact upheld by the Supreme Court decision. The handicapped case was brought in 1983 by the Paralyzed Veterans of America and other advocacy organizations for the disabled.

The Supreme Court ruling does not affect the current requirement that airports (which do accept Federal funds) must continue to be accessible to the handicapped with such devices as ramps, special rest rooms and the like. Airplanes do not have to be similarly equipped. In effect the rights of the handicapped air traveller stops at the tarmac.

In spite of these many difficulties, wheelchair passengers and other members of the disabled community are now travelling far more frequently than a few years ago.

Conclusion

This paper has been presented at the fourth and latest in a line of international conferences on the subject of mobility and transport for elderly and disabled persons, these meetings dating back to the Cambridge conference of 1978. Many problems still exist in the area, and will of course continue to exist as long as there are mobility disadvantaged people. In a number of the issues raised, there seems to be no more agreement than eight years ago, for example, parallel provision versus universal accessibility. Other areas such as co-ordination have not proved to be as fruitful as initially hoped. But in many areas real progress has been achieved. Air and long distance rail transport is now much more accessible and reliable for the disadvantaged; voluntary schemes for surface transport are now widespread and successful; the application of modern information technology to specialized transport is spreading beneficially. A number of areas have received scant consideration in the first four conferences - transport for the disadvantaged in developing countries and the whole problem of mobility of the elderly but in the future this will undoubtedly change.

These conferences have provided a method of international dissemination of experiences in various countries. As more countries participate, the value of the conferences will become greater, promoting as they do direct contracts between the large number of practitioners in the field and a consequent sharing of expertise.

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TRANSPORT PROVISION FOR DISABLED PEOPLE IN EUROPE: A REVIEW OF DEVELOPMENTS, TRENDS AND NEW INITIATIVES

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1. INTRODUCTION

This paper describes a major initiative in the field of transport for disabled people which has been taken by the European Conference of Ministers of Transport (ECMT). The ECMT is an inter-governmental organisation which was established in 1953 to be a forum for the Ministers of Transport of 19 European countries[1]. These Full Member states have a total population of over 400 million; Associate Members number four and include Canada and the USA. The work of the Council of Ministers is prepared by a Committee of Deputies. The purposes of the Conference are two-fold:

(a) To take whatever measures may be necessary to achieve, at general or regional level, the most efficient use and rational development of European inland transport of international importance;

(b) To coordinate and promote the activities of international organisations concerned with European inland transport, taking into account the work of supranational authorities in this field.

The ECMT studies major problems of transport policy and organisation, strives towards the development of European trunklines of communication, is in the forefront of European transport coordination (e.g. in traffic rules, road signs and signals) and prepares traffic trends and long term traffic forecasts. Moreover, the ECMT organises Round Tables and Symposia, whose conclusions often lead to the Committee of Deputies formulating proposals for policy decisions to be submitted to the Ministers.

The ECMT recognised that, although there has been rapid development over the past few years in many parts of Europe both in improving access for elderly and disabled people to mainstream public transport and in providing special transport services for their use, there has been little or no attempt to take stock of how far existing measures are succeeding in meeting the mobility needs of the disabled population or to assess the relative merits or benefits of different approaches. Furthermore, there has been very little exchange of information or coordination between states. Thus in May 1984, the ECMT held a seminar in Berlin at which representatives of five European countries presented papers on national policies and practices in the field of transport for disabled people. A strong feeling arose from the seminar that further international cooperation and exchange of information would be desirable.

Following an initiative at Ministerial level from the United Kingdom, the Conference therefore set up a Working Group towards the end of 1984 to investigate the issues of concern in the context of local (urban and rural), inter-city and international transport. The Group, under the chairmanship of the U.K. (and with the authors as Chairman and Rapporteur respectively), comprises delegates from 13 countries but has also drawn on material from a wider group of ECMT Member states.

2. FIRST STAGE OF WORK

The Working Group on Transport for Disabled People began by identifying the fields in which it would concentrate its activities. It was agreed that local transport is the most important factor in basic mobility, and that long-distance transport is only practical to use once a disabled person has mastered his/her problems with mobility at the local level. Accordingly, the Group focussed on private transport (i.e. the private car) and all forms of local public transport services, including the terminal facilities used by such services; consideration of long-distance transport was more limited. The definition of "disabled people" was taken to include people with all forms of permanent and temporary disability which reduced their mobility, including women in difficult stages of pregnancy. People encumbered with small children, shopping, luggage, etc., were recognised to have mobility handicaps, but were not specifically included. It is however a well-documented fact that improvements to transport facilities to help disabled people as defined by the Group, also help other people of reduced mobility.

It was also recognised that the term "disability" covers a wide range of very different impairments: physical, sensory and mental. In total this may represent about 42 million people in ECMT Full Member states, about 10 per cent of the population. This figure relates to medically, rather than functionally, based definitions of disability. In practice, medically-based definitions are not useful in transport planning, and the Group adopted the term "mobility-handicapped" to describe a wider range of people who have specifically transport-related difficulties. In doing so, the Group recognised that wheelchair users constitute a very small proportion of the total number (although in transport terms they tend to present specific problems). People with hearing and sight impairments and, in particular, frail elderly people are very much greater in number and can often be helped without elaborate or costly provision.

The Group's aim was to help both those countries which are already committed to providing for the transport needs of disabled people and those which are not yet actively involved. In order to achieve this aim, the Group felt that it would be valuable to examine some of the underlying issues. This examination began by looking not just at costs, but also at benefits, although these are often unquantifiable. The Group investigated whether possibilities exist for cross-sector or inter-departmental funding to take place, in recognition of the net benefits which accrue from providing independent mobility for a group of people otherwise dependent, in many cases, upon state funding. Finally, the Group considered the problems of estimating the demand for special transport services, and where and how a sensible balance might be established between supply and need.

As part of the Group's work, questionnaires were sent to all Member states of the ECMT, including those who had sent delegates to the Group, and the responses were analysed and discussed in the form of draft and final reports. The first report[2] of the Group reflects current approaches by participating Member states to providing for the transport needs of disabled people. While there is a great deal of well developed and well established provision throughout Member countries, the general picture which emerged is very clearly one of supply-led development. The conclusions of the report are summarised in the following sections.

3. BENEFITS FROM PROVISION OF TRANSPORT TO DISABLED PEOPLE

It proved difficult to establish quantifiable benefits or assess those which are unquantifiable or qualitative (e.g. improvements to the quality of life). However, from the examples which are available, some indications of the potential savings and benefits, both quantifiable and unquantifiable were obtained.

Qualitative benefits are, by definition, more difficult to assess but it is a well established and well recognised medical fact that keeping people independent and mobile for as long as possible improves both their physical and mental health, and thereby reduces the need for and the costs of care over the long term.

4. CROSS-SECTOR FUNDING OF TRANSPORT SERVICES

There do appear to be clear savings and benefits, particularly in the health and social services sectors, from providing transport which is accessible to and acceptable by disabled people. However, at present there is little provision in most Member states for transferring cost savings from these sectors into funding for transport services, except at the most localised government level of some countries.

Funds at "commune" or "parish" level may be able to be disbursed between different sectors according to locally-perceived needs. However the opportunities to achieve integrated and comprehensive services of all kinds are then necessarily constrained by the small size of the geographical area and the money (and other resources) available. Even at Ministerial level, dialogue between different departments does not always take place in a form conducive to collaboration in the sharing of either tasks or funds in a mutually supportive way.

Special transport services for disabled people will almost invariably appear financially unviable when assessed in traditional ways, in which the balance between capital/operating costs and farebox revenues is the main consideration. Recognition (in both intellectual and financial terms) of the wider socio-economic cross-sector benefits from transport provision - benefits which include both financial savings and improvements to quality of life - is needed for services to be developed.

5. BALANCE OF SUPPLY AND DEMAND

5.1 The Nature of Demand

One of the major problems in setting up or planning transport services for disabled people is the uncertainty or apprehension about the potential demand for them: an open-ended commitment is inevitably an unattractive proposition. Clearly, as more facilities are made accessible and opportunities are provided for disabled people to participate in a wider range of activities, demand for travel will increase. However, it is difficult to forecast patterns and levels of demand for travel by disabled people, since:

(a) Many disabled people have not previously had much opportunity to travel, and perhaps are also unaccustomed to the activities to which transport gives access.

(b) The travel needs of different parts of the disabled community vary, and are broadly similar to those of others in the same age group. However, travel needs of disabled people as a whole are different from those of the general population, because of the demographic structure of the disabled community.

(c) The necessary level of special services depends largely on how far conventional public transport has been adapted to cater better, or entirely, for disabled people (except those in wheelchairs).

A large proportion (50-75%) of mobility-handicapped people are in older age groups. The travel needs of elderly disabled people are oriented to the personal, domestic and leisure activities carried out at the places, times of day and rates (per day or week) of other older people. Some activities may be flexible in timing (shopping, visiting friends), while others may be tightly constrained (doctor or hospital visits).

Younger disabled people have the same desires as other people of their age: to go to work, to cater to domestic needs and to engage in a wide variety of entertainment and leisure activities. Their travel demands may be more intense and more time-constrained than those of elderly people, and possibly more so than those of other young people who are not mobility-handicapped.

Participation in these diverse activities is necessarily constrained by the transport available. Thus the travel patterns exhibited when there is little or no provision of special or adapted-conventional transport services will be a poor indication of future travel demand once mobility has been improved.

The picture is further complicated over time by the likelihood that the increased mobility of succeeding generations will be carried forward: when the young people of today become elderly they will have higher expectations than people who are currently elderly. And elderly people are becoming an increasing proportion of the population in many Member countries. Thus transport provision may be adequate for mobility-handicapped people today, but planners should allow for greater travel demand in the future.

5.2 The Roles of Conventional and Specialised Transport

It is clearly important to provide conventional transport which is more accessible to disabled people. There are well established ways of doing this for all aspects of the transport system: vehicle (and stop/station) design, route planning, information systems and staff training. Considerate behaviour by bus drivers has been shown to be an important factor in enabling elderly people to use buses. Many other forms of mobility handicap can be catered for cheaply and easily (even people in wheelchairs), especially when new facilities and vehicles are brought into service. There are many examples of successfully adapted public transport services.

It is also true that modifications which assist disabled people usually help all passengers to use the system more conveniently and do not adversely affect the levels of service provided for other passengers in terms of journey time, etc. As car ownership grows and public transport demand declines in many urban areas, the proportion of passengers who are elderly, women and children increases. Modifications to the system which help them will therefore benefit a growing share of the public transport market.

Improved conventional public transport will reduce the level of the more costly special services which have to be provided for disabled people. There are several examples from Member countries of taxis being used to carry disabled people who need a door-to-door service (and are thus unable to use fixed-route public transport) but who do not require the very high level of care provided by special services, such as dial-a-rides. So long as suitably designed vehicles are used, taxi services can provide another form of cost-effective transport. Special services will then be required to cater for journeys for which conventional public transport is unsuited. The cost per trip may then be high, as the market is very specialised in its clientele and may have a widely spread pattern of use. But the overall cost should be lower than trying to cater with special services for all people who cannot use non-adapted conventional public transport.

5.3 Planning for Future Demand

The more specialised the market for special services becomes, the more difficult it is to forecast the level and pattern of demand. All public transport use is regulated by the availability of services, cost and other factors, including the actual or perceived quality of service compared with alternative modes of transport (usually the private car). Especially for urban travel, the number, length and cost of trips made by the population in any time period is fairly constant and the choice is between transport modes or competing destinations, rather than between travelling and not.

There are some differences in planning transport for disabled people, due to some extent to the characteristics of this sector of the population - notably the prevailing assumption that improved transport provision for them would in most cases cater for "marginal" or "optional" trips, i.e. their alternative is not to travel at all. In practice, special transport services draw on a clientele who in part currently travel only rarely or with great difficulty by conventional public transport services, who in part rely on other people to give them lifts in private cars, or who do not travel but generate additional travel on their behalf by family and friends, or the staff of voluntary or state agencies.

Travel by disabled people on new or improved special transport services will therefore partly replace trips made by them or other people by conventional public transport or by car, and will partly be "new" trips to carry out activities not previously performed. In addition, there will be some people who currently do not travel at all, who will start to use special services once they are available and then, once they have built up their confidence and level of knowledge, change to using (adapted) public transport for some of their journeys. The estimation of demand is therefore more complex than when planning a new service in a conventional urban transport network.

To a greater extent than for conventional public transport, it is possible to control the rate of growth of special services for disabled people by governing the number of vehicles or the level of subsidy, or by other means. Ridership will be particularly affected by the services' flexibility, accessibility and availability, across a time period or spatial area.

From those countries where provision of special services is well established (such as Sweden), evidence suggests a steady, although in some cases slow, rise in demand over a number of years until a plateau is reached. In Sweden, the number of people registering to use special services is stabilising at about four per cent of the population (18 per cent of the elderly); costs are stabilising in parallel. Those services which have reached capacity soonest are those which permit self-defined mobility-handicapped people to travel to and from any place within their local area at any time of their choosing. Services with restrictions on clientele (e.g. through requirements for doctors' certificates), accessibility (a fixed-route service from "the end of the road" rather than a demand-responsive service "to the door") or time (only one or two services a week to each residential area) may be provided more cheaply than demand-responsive services. However these more restrictive services will serve fewer people's needs.

The cost-effectiveness of any type of service has to be considered both in financial terms (the net cost of providing each trip, after fare revenue) and in terms of the overall costs and benefits of increased mobility for the numbers and types of people involved. It is crucial to monitor both ridership and reasons for non-use, and to adjust a service to reflect the needs of its users and non-users, to achieving a successful operation.

With the likely future growth in demand, especially in the long term, planning has to be focussed on an eventual level of overall transport supply for disabled people which is greatly in excess of that available in any Member state today. Much can be provided through modifications to, or better planning of, conventional public transport services (including taxis), leaving the residue to be provided by special services. Swedish experience has shown that savings can be achieved simply by better coordination between transport services operated by taxis and special service vehicles.

In an area as new and untried as this, there are advantages in starting special transport schemes on a modest scale and achieving gradual progress while keeping control of the nature and pace of development and growth. This should lead towards more firmly based services, which develop along cost-effective and efficient lines, and can be sustained.

6. THE NUMBERS AND NATURE OF DISABLED PEOPLE

The Working Group used its questionnaires to try to establish the number of disabled people in each country. In making comparisons between the figures which were provided by different Member states, it became clear that there is little or no standardisation of data. Each country collects information for its own needs in providing special facilities or making financial provision for disabled people; as these provisions vary between countries, so does the type of data collected. Few countries have collected data on disabled people specifically from the point of view of mobility handicap. In some cases delegates were able to supplement official information with data from other sources, to present figures for a range of disability more in line with the definition drawn up by the Working Group.

For any one country there is often a range of estimates provided by different sources. Excluding the few percentages which appear to be very considerably higher or lower than for most of the other countries, the figures appear to

fall into one of two groups: 5-8 per cent or 10-13 per cent of population; for some countries different sources yield estimates in both of these ranges. The differences appear to be mainly due to differences in definition, or in quality of data collection, rather than real differences between countries.

A reasonable estimate appears to be about 10 per cent (this was also the figure used during the United Nations International Year of Disabled People). The population of the ECMT Member countries in 1981 was about 420 million. Thus the number of disabled people throughout all Member countries is likely to be about 42 million.

7. DISABLED PEOPLE AND CARS

Numerous surveys show that, for those disabled people who can drive or who have someone else to drive them, the biggest single aid to personal mobility is a private car. Furthermore, there are strong indications that having a car available is a key factor for these people in obtaining and keeping employment. The Group therefore investigated the numbers of disabled drivers and adapted cars in Member countries, and practices relating to the provision of cars (adapted, as appropriate) for disabled drivers and passengers.

However, most countries do not have a special definition of "disabled driver". Many European Community members, and some others, operate the principle that if a disabled person can demonstrate competence to drive, an ordinary licence is issued (restricted as appropriate if a specially adapted vehicle is needed). Mainly for this reason, statistics on the numbers of drivers and of adapted cars are not readily available and, where they are given, they are often based on different definitions and assumptions.

8. RESPONSIBILITY FOR LOCAL TRANSPORT PROVISION

There is a wide variation of responsibility for the provision of local transport for disabled people, among the countries reporting to the Group. In most countries, local (municipal or rural district) authorities are responsible for the provision of transport for disabled people, supplemented or replaced as a funding source in some cases by regional government bodies where these exist. Notable exceptions, where central government plays a direct role in funding and organising transport for disabled people, include Ireland, Luxembourg and the Netherlands; however, in other countries funds from central government are often passed to local government to assist them in their task; this can be done as a specially-designated fund or as part of a general support grant for all public transport services. School transport or transport to medical centres are often provided as a separate service.

The responsibility for, and the funding of, transport for disabled people is to a large extent dependent on the way in which service provision is divided between the operators of conventional public transport and operators of special services, which may be funded and operated by a variety of bodies.

9. THE PATTERN AND COSTS OF TRANSPORT PROVISION

There is clearly a wide range of levels of provision of transport services for disabled people, and their nature is to a large extent determined by the differing responsibilities for its provision noted above. It is clear that

local transport presents more difficulty than long-distance rail, air or shipping services. Some countries appear to be trying all kinds of local transport provision in parallel; these include adapted public transport, taxis, special services of various kinds. In several countries, especially where there is strong regional government involvement, different systems are being tried in different places.

Other countries are making efforts with regard to long-distance transport, especially when new stock or new lines are installed, but local transport is hardly accessible or local special services are restricted to certain areas of the country only.

Taxis are provided at free or reduced fares throughout some countries, or only in some parts of others. In areas of low population density, shared taxis or taxi-type services with larger vehicles for disabled people are commonly integrated into conventional public transport.

In Italy, unlike the other countries reporting to the Group, the emphasis appears to be on trying to provide personal mobility for as many disabled people as can drive or otherwise use a private car.

One common theme is that adapted public transport in urban areas is not generally suitable for passengers in wheelchairs, because of the cost of equipping the bus and the delay to other users. However the bus stops with raised platforms which are in use in Norway and Sweden have demonstrated a possibly useful alternative approach to bus boarding problems.

The need for better coordination of different types and operators of special services is another common problem. Canada's demonstration project in Vancouver and Edmonton is of relevance in this regard.

Levels of provision of information also vary widely. In some cases it is left to disabled people's organisations to circulate information, in others it is assembled and widely distributed by state organisations.

10. NATIONAL POLICIES FOR TRANSPORT FOR DISABLED PEOPLE

Many Member countries appear to fall into one of two groups:

(a) those which have no formal policy or legislation with regard to transport for disabled people; and

(b) those which have highly structured policies and detailed legislation.

However, those in group (a) frequently have some legislation or code of practice for access to buildings and it appears that specific policies for transport may follow. Even countries who have not reported any existing or potential legislation have practices which are helpful to disabled people (e.g. services and fare concessions).

Some countries have some legislation and appear to be evolving standards and practices in a progressive manner; others currently have policies without specific legislation.

In almost all cases, some progress is being made through a combination of national or local government measures, lobbying by special interest groups or initiatives taken by transport operators themselves. There is considerable success, in terms of the quality of service for disabled people, to be found in some of the countries which have no offical policy; other countries appear to need the reinforcement of legislation or regulatory guidelines to achieve progress in this field.

11. RESPONSE TO EARLIER ECMT INITIATIVES

It is obviously important that recommendations lead to action. The ECMT therefore has a practice of following up the progress made in implementing its Resolutions. The Working Group thus sought to establish the response which had been made to an earlier Resolution on transport for disabled people (number 38 of 1978), which recommended that, inter alia, governments:

- pursue the design and introduction of improvements intended to give handicapped persons easiest possible access to existing transport services including long-distance services;

- seek in this connection to make it less burdensome and easier for handicapped persons and old people to use these services by planning appropriate measures regarding access to terminal facilities and vehicles.

It was clear from the information provided to the Group that considerable progress has been made towards making at least the more important of the conventional main-line trains, and air and shipping services, accessible to people in wheelchairs. It appears that for long-distance travel, disabled people are better integrated with the general travelling public. However the long-distance special transport service of Sweden is of great interest, in that it permits severely disabled people who cannot use conventional trains to travel by a mode which is usable by them, including air, taxi or special road vehicles, for the cost of a second class rail ticket.

12. THE NEXT STAGES OF WORK

On the basis of the deliberations and research of the Group, as detailed above, a resolution was drawn up (Resolution 54, which is appended to this paper) and put first to the Committee of Deputies and then to the Council of Ministers, who unanimously endorsed it in October 1985.

Furthermore, the Group was charged to continue its work, first to move towards the implementation of Resolution 54, and secondly to investigate further areas of transport for people with reduced mobility.

The new areas which are currently under consideration are twofold:

(a) pedestrian and wheelchair access and facilities, including pedestrianised and space-sharing areas; and

(b) more detailed consideration of long-distance domestic and international travel including terminal facilities for aviation and shipping services (although not the aircraft and vessels themselves).

Further questionnaires on these topics are being circulated and discussions held with a view to reporting back to Ministers in April 1987, after consultations with consumer groups.

With regard to the aspects of implementation of Resolution 54, the Group has just begun to give further consideration to the following areas:

(a) classification, identification and measurement of cross sector benefits and the ways in which these may be recognised by transfer of funds between government departments and other agencies;

(b) standardisation and harmonisation of measures between Member states with regard to the standards of provisions made and regulations affecting transport for disabled people; and

(c) standardisation of definitions and harmonisation of statistics in relation to mobility handicap.

13. CONCLUSION

The ECMT initiative described in this paper, to set up a joint forum of its Member states, has enabled participants to work together on problems of common concern. The Working Group has demonstrated the benefit of sharing experiences, problems and solutions; already benefits have arisen from the coordination and exchange of information on research and development, both between Member states and on a collective basis. The authors believe that Working Groups of this kind, working under the auspices of distinguished international bodies such as the ECMT, provide politically high profiles for work in the field and also provide a basis for common understanding and practical achievement at the working level.

FOOTNOTES

1 Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxemburg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom, Yugoslavia. Associate members comprise Australia, Canada, Japan and the United States of America.

2 Transport for Disabled People; International comparisons of practice and policy with recommendations for change, ECMT, 1986 (also available in French).

APPENDIX

RESOLUTION ENDORSED BY MINISTERS

The Council of Ministers of the European Conference of Ministers of Transport, meeting in Paris on 20-22 November 1985,

HAVING REGARD TO

- the present report on Transport for Disabled People [CM(85)19];
- Resolution No. 38 of 1978, which stressed the need to "pursue the design and introduction of improvements intended to give handicapped people easiest access to existing transport services including long-distance services";
- Resolution No. 45 of 1981, which emphasised the importance of "adapting existing transport installations wherever possible to facilitate wheelchair access";

RECOGNISING THAT

- one of the objectives of transport policy is to provide a free choice of means of transport (within national and international regulatory frameworks and economic constraints) to meet the need for safe low-cost mobility for all people, including those with disabilities;
- the wider socio-economic cross sector benefits from transport provision for disabled people should be taken into account by Member governments, both within and between government departments and that, where appropriate, measures should be taken positively to identify these benefits;

MAKES THE FOLLOWING RECOMMENDATIONS:

Statistics and Definitions

Although the data on the number and nature of disabled people are now more comprehensive than at the time of the earlier ECMT resolutions, it is still difficult to make realistic comparisons between countries. It is therefore recommended that statistics be established in relation to mobility handicap/transport disability. Towards this end, available data should be collated with a view eventually to drawing up a set of unified definitions. Recognising that statistics will be required in the first place for national use but also for international purposes, these definitions should be consistent between countries and within countries, so that comparisons can be made without difficulty and duplication of data collection is avoided. Definitions should be related to degree of disability as it affects mobility, rather than to cause. The definitions and associated data and/or statistics would be used, inter alia, for:

(i) compilation of comparable statistics between countries as a basis for planning; and

(ii) introduction of reciprocal benefits and concessions.

Coordination, Research and Information

It is recommended that more efforts be channelled into coordinated research and exchange of information on all measures to assist with the problems of people with different types and degrees of mobility handicap. This would include:

(i) regular international exchanges of information about proposed areas of research as well as published research reports;

(ii) exchange visits at technical and administrative levels;

(iii) possibility of joint projects and publications; this may be arranged either directly between two or more countries at government or other levels, or under the auspices of ECMT.

Coordination and Standardisation of Measures

It would be highly desirable to strive for the coordination and standardisation or reciprocal recognition of measures to help disabled people travel between Member states, and to encourage similar coordination between different schemes within each Member country.

There is already reciprocal recognition between Member states of parking concessions for disabled people. This concept could be extended to other areas, for example concessions and tariffs for train travel, standardisation of a distress sign for disabled drivers, harmonisation or mutual recognition of legal requirements like seatbelt wearing exemptions for car users; the need to standardise wheelchair anchoring methods should also be discussed.

There should also be recognition of the need to monitor developments in all policy areas affecting transport, in order to ensure that the interests of mobility-handicapped people are not inadvertantly adversely affected (relative to the population as a whole), for example, by tax changes (fuel, VAT), new fare collection systems, measures to combat vandalism, etc.

Guidelines and Standards of Transport Provision

It would also be highly desirable to draw up guidelines on standards of provision for disabled people in vehicles and in all transport-related facilities, taking account of ISO standards as appropriate. Again, the Working Group would incorporate consideration of guidelines in its programme of work. These would take the form in some instances of specifying minimum acceptable standards (e.g. of physical adaptation of vehicles and transport related buildings), whereas in other instances it would be more appropriate to express levels of access as an objective, to be interpreted according to local needs and conditions.

Measures for Implementation

It is recommended that to facilitate better use of all means of public transport by mobility-handicapped people, each Member country should strive

to meet the objective that ultimately all transport systems, and their support services such as toilets, catering and telephones, should be usable by mobility-handicapped people and that as a matter of course all new systems should be planned to be usable by mobility-handicapped people, recognising that:

(a) It is in general much more expensive, and often less effective, to modify existing infrastructure and vehicles than to make new infrastructure and vehicles usable by mobility-handicapped people.

(b) It is also often possible to introduce measures to improve transport systems for the majority of mobility-handicapped people but which are not sufficient for those who need lifts or ramps for access. In some cases, the provision of lifts or ramps in existing systems is physically impossible due to lack of space.

In particular, it is suggested that measures be taken by Member countries to meet:

(i) the need for long-distance main-line trains and main-line railway stations to be made accessible to mobility-handicapped people unless an alternative form of long-distance transport is available (1);

(ii) the need to make new rolling stock and stations on light railway and metro networks accessible to mobility-handicapped people, while bearing in mind that it is usually a less efficient use of resources to modify existing local rail rolling stock and stations, especially for disabled people in wheelchairs;

(iii) in those countries which have separate buses for long-distance transport, the need to improve the accessibility for mobility-handicapped people to new long-distance buses and coaches on scheduled services, and to bus stations used by them;

(iv) the need to design local buses to be as easy as possible for people of reduced mobility to use, although not necessarily to make these accessible to people in wheelchairs;

(v) where existing public transport is not accessible to disabled people in wheelchairs, the need for other local transport services to be made available, using accessible taxis, dial-a-ride services with accessible vehicles, or other special transport services, depending on what is most appropriate in local conditions, at reasonable fares;

(vi) the desirability of providing assistance to disabled people for whom the purchase and operation of a car is deemed to be essential for their work or to enable them to live in the community;

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(1) Where the word "Accessible" is used in the text, this is intended to imply the provision of fully accessible facilities, such as toilets, telephones and restaurants.

(vii) the need to make easily available to disabled people, their relatives and friends, people working in the field of disability, and transport operators, information on all aspects of independent mobility, including transport services, financial assistance and any other services. This includes the provision of guidelines on the establishment and operation of transport services and facilities for disabled people;

(viii) the need to provide associations representing disabled people with the opportunity to play a part in the planning of major transport projects.

INVITES

Transport Ministers in Member countries to encourage Ministers in other departments (e.g. public works, health, social services and finance) to recognise and work towards the objectives suggested by these recommendations;

INSTRUCTS

the Committee of Deputies:

- to keep them informed of the action taken to implement this resolution and to report back in due course;

- to undertake further work in this field and to report on developments within two years.

BRITISH RAIL'S APPROACH TO DISABLED TRAVELLERS

William G. Buchanan

Special Advisor on the Disabled
British Railways Board
London, England.

BRITISH RAIL'S APPROACH TO DISABLED TRAVELLERS
-BY- WILLIAM G. BUCHANAN, SPECIAL ADVISER ON THE DISABLED

During the International Year of Disabled People, the Chairman and Board of British Railways undertook the commitment to make rail travel in Britain possible for disabled people. Accordingly, they appointed a Special Adviser, himself severely disabled and with the added advantage of many years' senior-level experience with Canadian National Railways. At the same time, he was appointed Chairman of British Railways Board's Advisory Group on Transport for the Disabled which is composed of representatives from the major disabilities as well as BR's business, architectural, technical and design departments.

With the Adviser in a position of liaison, understanding not only the difficulties of the disabled who wished to travel by train but also the problems facing the Railway officers and staff directly involved, a strategy was developed which would use available financial resources to maximum effect.

BR has two distinct disadvantages over railways elsewhere in catering for the disabled; first, the majority of its stations were built in the nineteenth century when elegant staircases were the fashion and second, passenger coaches have a tight loading gauge that imposes severe restrictions on space for wheelchairs within passenger coaches. However, BR possesses a major advantage in the form of higher platforms which make boarding and alighting a lot easier than on many European and North American railways.

BR is committed to developments for the disabled which go well beyond existing legislation. It aims to give all disabled people, including wheelchair-users, the sight and hearing impaired, and the ambulant disabled, the opportunity to travel confidently and as independently as possible. To this end, an integrated approach to train and station design, staff training and linkage with other transport services has been evolved.

The British Railways Board has directed that the needs of the disabled must be considered when designing new, or refurbishing old stations and rolling stock.

The InterCity trains, which serve the main rail network, are equipped with wide access doors, grabrails, self-opening interior doors and wheelchair accommodation. Contrasting colour schemes and public address systems help the partially sighted. 60% of InterCity coaches have space for wheelchair-users to travel in the passenger saloon and this will rise to 80% by 1987. On-train toilets, which can be used by the wheel-chair-bound are being installed in eleven existing vehicles serving the London-Glasgow route and disabled toilet facilities are being included in all new builds of main line stock. For those unable to reach the restaurant car, meals and snacks can be served at their seats.

On local and cross-country services, almost all the existing fleet of multiple units will have been replaced by sliding-door stock within the next five years. Wide door openings and low floor levels give easy access to all, including the wheelchair-bound. Some train sets in the cross-country services used on the longer-distance journeys will have toilet facilities for the wheelchair-bound.

In London and the South-East commuter area, some existing "slam-door" stock with narrow doorways unfortunately has a long life expectancy and rebuilding to admit wheelchairs is not possible either financially or structurally. Hence, many guards' vans are being upgraded to provide a more comfortable environment for wheelchair travellers and their companions unable to enter the passenger coaches.

BR has equipped a core system of fifty-seven principal stations serving the major centres of population with top-class access and facilities for the full range of disabled travellers [See Appendices 'A' and 'B']. the needs of the disabled have also been taken into account at other stations, especially those serving hospitals or special schools. Also, developments have taken place at many secondary stations with priority given to low-cost improvements, such as induction loops at ticket office windows to help hearing-aid users, white marking of platform edges to assist the blind, and dropped kerbs at entrances for wheelchair-users and the ambulant disabled. Completely accessible stations are being developed on the satellite concept, one totally accessible station serving a catchment area which is then tied in with other modes of transport such as dedicated disabled bus services and Dial-a-Ride. Although all these provisions are designed to serve the disabled, rail travel also automatically becomes easier for mothers with prams, the edlerly, and those with heavy luggage.

BR has not been able to rely on any special funding for disabled facilities. With tightening commercial targets, the BR business sectors are finding investment in facilities which benefit only a small proportion of customers harder to justify on financial grounds. BR therefore encourages either joint funding or direct sponsorship for facilities (including disabled) from outside bodies such as local authorities, businesses and voluntary organisations. Many new stations have been opened, and existing ones rebuilt, as a result of partnership schemes. One major initiative, jointly financed by the Greater London Council and British Rail, has improved facilities for the disabled at ninety-seven stations in the Greater London area.

Severely disabled people, often on a limited income, would find it almost financially prohibitive to travel by train. Thus, a Disabled Persons' Railcard was introduced to enable them to travel at reduced fares as well as giving the same reduced rate to a companion. Disabled travellers are urged to give advance notice of their journey plans, so that staff can be detailed to provide any assistance needed. A computerised message

transfer system is planned to improve internal communications still further.

Staff training is of course paramount to success in providing disabled travellers with the kind of service they need and deserve. Our film, "Just like the rest of us", shows the problems facing disabled travellers and the means of overcoming them. A second film, now in the final editing stage, shows in precise detail how to assist the passengers, whether they are blind, deaf, ambulant disabled or in a wheelchair.

Now that the major part of the trunk network is equipped for severely disabled travellers, British Rail will actively promote the real advantage rail offers them as a means of transport. Linkage with other transport modes will achieve the ultimate aim of door-to-door long-distance travel for severely disabled people.

APPENDIX 'A'
DISABLED ACCESS AND FACILITIES: 'CORE SYSTEM' STATIONS

EASTERN REGION	King's Cross
	Peterborough
	Doncaster
	Leeds
	York
	Darlington
	Newcastle
	Liverpool Street
	Ipswich
	Cambridge
	Norwich
	Sheffield
LONDON MIDLAND	St. Pancras
	Milton Keynes
	Coventry
	Derby
	Euston
	Watford Junction
	Rugby
	Birmingham International
	Birmingham New Street
	Stoke-on-Trent
	Chester
	Manchester Piccadilly
	Liverpool Lime Street
	Preston
	Carlisle
	Nottingham
	Crewe
	Leicester
SCOTTISH REGION	Edinburgh
	Dundee
	Aberdeen
	Inverness
	Glasgow Central
	Glasgow Queen Street
SOUTHERN REGION	Victoria
	Waterloo
	Charing Cross
	Basingstoke
	Salisbury
	Bournemouth
	Southampton
	Brighton
	Gatwick Airport
	Dover Priory
	Portsmouth and Southsea
WESTERN REGION	Paddington
	Reading
	Bristol Temple Meads
	Exeter St. David's
	Plymouth
	Cardiff Central
	Swansea
	Oxford
	Bath
	Gloucester

APPENDIX 'B'

FACILITIES FOR THE DISABLED AT 'CORE' SYSTEM STATIONS

1. Dedicated car parking spaces conveniently sited

2. Signing to indicate easiest routes and call-for-assistance facilities

3. Station wheelchairs

4. Induction loops at ticket office and travel centre sales counters

5. Electronic information display systems

6. Disabled toilets accessible with "National Key System" key

7. Lifts operated by passengers or staff

8. Access to catering facilities

9. White marking of stair heads and landings

10. Handrails on all staircases

11. White edges to platforms and grooved coping stones

12. Medium-level payphones

13. Inductive coupled payphones

14. Portable ramps for wheelchair access to trains

THE HOUSING INTERFACE AND ITS INFLUENCE ON MOBILITY AND TRANSPORTATION FOR ELDERLY AND DISABLED PERSONS

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THE HOUSING INTERFACE AND ITS INFLUENCE ON MOBILITY AND TRANSPORTATION FOR ELDERLY AND DISABLED PERSONS

A paper presented at the Fourth International Conference on Mobility and Transportation of Elderly and Disabled Persons. Vancouver, July 1986, by John H Bails Senior Research Officer, SA Department of Housing and Construction, South Australia.

THE INTERFACE IS IMPORTANT

Minimising the affects of restricted mobility and difficulty of access for the elderly and disabled is socially desirable, is supportive of maximum independence and, in most situations, is economically justifiable.

Mobility and the use of facilities by the elderly and disabled to meet their realistic expectations and needs requires much more than just the features of vehicles and buildings, it also involves movement to and from vehicles, and movement between buildings.

The advantages of attention to consumer needs within established transfer systems and within commercial, residential and recreational buildings and environments are significantly negated if the transition mechanism is ineffective and people are unable to move about.

The interface, that area for movement between buildings and between buildings and vehicles, is sometimes handled with skill and understanding. But all too often, it is less than effective for use by the elderly and disabled.

The design of the interface includes the design of land use, land subdivision, road and movement pathways systems, constructions, site works, transport vehicles, terminals and stopping areas.

The importance of the interface cannot be ignored.

More often than not, for use by the elderly, the design of the interface is a disaster.

Internationally and locally we lack a proper understanding of the needs of the elderly, we lack standards to prevent bad practices, and we take a short term economic view. We are spending millions of dollars providing facilities that in a few years time will be seen as grossly inadequate for the needs of up to 20% of the people in our community.

The challenge I present to you is to give greater emphasis to developing efficient economical and practical access mechanisms in the interface to allow more opportunities for easier and independent movement of all users not only the elderly and disabled but also mothers with young children and other adults with handicaps.

Although a few international and local standards exist that theoretically meet the needs in the interface it is obvious that many practical difficulties remain unresolved.

SERIOUS INTERFACE PROBLEMS

How bad is the situation in respect to the design of the interface? Here are a few examples of problems with access facilities that in many cases conform to existing standards and are seen by approval authorities as suitable for use.

We have 1:12 Ramps 9m long that suit many young paraplegies in wheelchairs and some fit ambulant disabled persons, but which are hopeless for the more disabled wheelchair user and many elderly people particularly if they also have a disability.

We have short ramps at 1:6 gradient down which some users cannot stop from skidding and that cause some users to tip over backwards when they attempt to ascend these steep inclines.

We have bent and curved ramps that cause most wheelchair users to go on three wheels and get out of control.

We have steps with 150mm rises and 300mm long treads that suit some ambulant disabled but are hopeless for most walking frame users many crutch users and a lot of elderly persons.

We have raised thresholds to doorways and kerbs to roads that, to many, are barriers to access.

We have cross falls to footpaths in excess of the need for water run off that makes these movement pathways difficult and often dangerous for use by many elderly people.

We have difficult to see ledges slopes and rough patches in movement pathways that cause many elderly people to stumble, fall and break bones.

We have 25mm high ledges and gutter slopes that can catapult wheel chair users head first out of their wheelchair.

We have retired persons finding purchased accommodation and retirement villages, supposedly suitable for their future use, quite impossible to use should they suffer a mobility disability or become physically frail as they age. Some people find themselves virtually imprisoned remote from the rest of the Community.

It seems the general practice is for designers to design to the worst that the local laws will allow and not to suit the real access needs of people. Or perhaps it is ignorance, with designers believing that regulations and codes truly reflect the needs of the majority of disabled persons and that the needs of aged persons are satisfied by facilities classified as suitable for the disabled. Travel distance and access to generic services are often ignored.

We nearly always provide much better access facilities for motor vehicles than we do for the elderly or the disabled. Drivers would not tolerate such hazards but the elderly and disabled are expected to put up with these examples of poor and dangerous design.

THE NATURE OF STANDARDS

To understand how we manage to produce such unsuitable access provisions we must look at the nature and status of international and local access standards.

Engineering standards are often quite precise documents. They say for example, "design for a wind forced of 10 lb per square foot and keep all stresses in mild steel to not more than 10 tons per square inch and your building will be safe to use."

You so design, and the building does not fall down, it works and everyone is happy. You can believe the standard.

Disability standards are quite different. On the one hand they are often quite dogmatic, stating, for example, a ramp must not be steeper than 1:12 and 9m long. On the other hand, such standards rarely say who will be able to use such a ramp or state the significance of departures from standard. You design and construct 1:12 ramp 9m long, believing the standard but find to your dismay that a lot of disabled people are unable to access the ramp.

Standards in the field of design for disability take years to be developed and to be approved. They are compromise documents that reflect not only the needs of users but also the desires and opinion of property owners, architects, developers legislators and approval authorities to mention just a few.

The research on which some standards data are based is rarely mentioned.

Our research on 1:12 ramps 9m long yielded similar results to those found at Syracus University and presumably used to develop the USA standard ANSI A117.1-1980. We found only about 35% of our sample of disabled persons aged 18- 60 years could access such a ramp.

Not many people realise that 65% of the disabled population aged 18 to 60 years cannot handle a ramp of this grade and length. Ramps of this type become increasingly useless to people as they age even though they have no obvious physical disability.

INTERNATIONAL STANDARDS

Despite intense efforts by many dedicated people the International Standards Organisation has made limited progress with respect to design for the elderly and the disabled.

Now 10-15 years down the track what have we got?

Some data on the structure and dynamics of wheelchairs.

A set of pamphlets on the design of buildings for the disabled.

Very little on the design of building and the environment for the aged.

Very little on design for children.

Very little on the design of facilities for the mentally retarded or demented.

Our Australian Code AS 1428 covers basically access to public buildings for persons in the age range 18 to 60 years. This code, which is not unlike many overseas codes, has been found by field testing to be very inadequate and is currently subject to major amendment. We have virtually nothing in the area of design for children or for the aged. Nor have we reliable data for the design of domestic dwellings, educational and recreational, sport and entertainment areas. We tend to apply the inadequate provisions of AS 1428 to every age group and to all places often with disastrous results. We are currently checking all our standards to see if they meet the needs of the elderly.

COSTS AND BENEFITS OF GOOD DESIGN

Within 10 years nearly 20% of our population will be over 60. This over 60 age group will be a major political force in many communities. Compared to previous aged groups they will live longer, they will be intellectually better informed, they will be far more demanding. They are not likely to tolerate the provision of nonsensible access facilities that are so evident at present in most countries including Australia.

Some people claim it is too costly to provide proper access facilities for the elderly and disabled. I say it is going to be too costly economically, politically and socially to not so provide.

Based on Australian conditions the cost benefit of proper design of the interface is in the order of $500 000 000 per one million of population. This type of benefit is available to all countries with similar cultures by simply designing the interface so that elderly people can remain independent for an extra 5 years during and average 25 years of retirement. We can and should design to obtain such benefit.

AGE SPAN DESIGN

With a massive stock pile of dwellings, other buildings, urban environments, and transportation systems (all generally quite unsuitable for use by elderly and disabled persons) we are now, in Australia, producing large quantities of retirement villages and associated services with little guidance and often with little care for the future needs of the people we expect will use these facilities.

To encourage the adoption of a commonsense approach to developments for use by elderly and disabled persons we have initiated and are proposing acceptance of a technique called "Age Span Design".

This technique makes it possible to design adequate access features and facilities for selected periods of use by persons whose characteristic and access needs change with age. The technique uses identifiable design priciples, rules, data sheets and design criteria appropriate to the physical and cultural characteristics of various communities, and accommodates the needs of particular known users. Each stage of design and each decision leading to the final design is easily documented allowing for review and checking by others if desired.

The technique is appropriate for use in all areas of design for access including land use, transport sytems, movement pathway systems, land subdivision, siteworks, transport vehicles, stopping points and terminals, private and public building, domestic dwelling and places for learning sport, recreation, entertainment and pleasure. The only limitation at present is the availability of suitable design guidelines or agreed standards covering some specific areas of design.

Design guidelines for design of the interface for persons aged 60 to 100 years are available.

Good design requires the use of the best available information, selection from among alternative options and wise compromise where needs conflict.

It is considered impossible to design a single facility or detailed feature that will suit persons of all ages and with any type of disability. Age Span Design aims to satisfy the needs of 80% of users and predicts characteristics, abilities and needs of the users based on age.

On this basis the above factors of information selection and compromise are embodied in the following data sheets used in Age Span Design. Samples of these data sheets, based on Australian conditions, are included in the appendix.

Data Sheet 1 - Probability of Disability Chart

This chart lists against age the type of mobility aid at least 20% of persons 60 years of age and over are likely to be using.

Data Sheet 2 - Critical Status Chart

This chart identifies the mobility aid that is most critical with respect to the design of various access features. As an example the space needs and abilities of a person using a walking frame are critical in the design of steps while the characteristics of wheel chair users are of no consequence in step design.

Data Sheet 3 - Desired Destinations and Areas of Use Charts

Again based on age these charts show for particular groups of persons the places they will wish to visit and the areas they will expect to be able to access. The expectation and needs of persons in a nursing home are not the same as those for persons living in hostels or in private homes and therefore separate charts have been developed covering

Nursing Home Living

Hostel Living, and

Private Home living

Data Sheet 4 - User Capability Charts

These age charts show for fit and disabled persons their capabilities to travel, to access ramps, steps etc. These charts have been developed from field test data for persons up to 60 years of age and use medical research data for fall off of energy as people age beyond 60 years. Where physical size and shape are critical to design these data are used in place of energy predictions for ages 60 to 100 years.

An example of the application of "Age Span Design" to the design of the interface for elderly and disabled persons will illustrate the ease with which this technique handles complex and involved design problems.

The case considered involves retired elderly persons to be housed in hostel type accommodation on land that is undulating. The aim is to design the interface to maximise the opportunity for these people to remain mobile, retain their independence and continue for as long as possible to make use of generic services and be active members of the community.

Example of the Age Span Design Technique

The design process consist of five steps.

1. Decide the age and characteristics of users.
2. Decide where they will want to move.
3. For each area of movement decide the critical status.
4. Identify users capabilities.
5. Select design features to suit users needs.

The following description of the design steps should be read in conjunction with the illustrated examples in the appendix.

Step 1

It is assumed a requirement of the design is that the facilities should be suitable for use by persons aged 60 to 90 years and that the needs of the following intending users must be met:

A 69 year old who walks with difficulty using a stick and a tripod.
A 76 year old arthritic who uses a walking frame
and an 86 year old who is very physically fit and needs only a walking stick for mobility.

Using the Probability of Disability Chart the future mobility conditions of the known potential users is added to the conditions of the unknown users to develop a Project Status Chart as below.

PROJECT STATUS CHART

AGE	UNKNOWN USERS	USER A	USER B	USER C
60 - 64				
65 - 69	Stick			
70 - 74	Tripod			
75 - 79				
80 - 84	Walking Frame			
85 - 89	Manual	Elec		

Step 2

Using the area of movement chart for hostel living identify the age of persons who will desire to use the movement pathways between building entrances and exits and road side car pick up points. In this case the people involved are

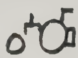
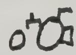
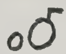
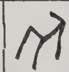
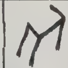
Physically fit persons up to 90 years of age, and
Disabled persons up to 80 years of age.

Step 3

From Step 1 above the aids used by persons identifed at Step 2, include

Using the Critical Status Chart and the above data a Project Critical Status Chart is compiled as below.

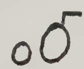
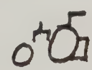
PROJECT CRITICAL STATUS CHART

	TRAVEL DISTANCE		RAMPS		SINGLE STEP		RISE AND TREAD OF STAIRS	
	AID	MAX AGE	AID	MAX AGE	AID	MAX AGE	AID	MAX AGE
Least Critical		80		80		69		69
		69		69		79		79
		80		79		80		80
		79		80				
Most Critical		80		80				

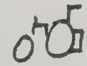
Step 4

Using the appropriate User Capability Chart the following Critical Design Data can be obtained.

A. <u>Maximum horizontal travel distance from building entrance or exit to road side pick up point</u>

Aid	Fit no Aid					
Age	90	80	79	80	69	80
Distance	500m	90m	95m	120m	90m	180m

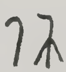
B. <u>Maximum gradient and length of ramp if used in this movement pathway</u>

Aid	Fit no Aid					
Age	90	80	80	79	69	80
Gradient	1:33	1:22	1:20	1:22	1:18	1:22
Length	7.5m	5m	3m	5m	7m	9.5m

C. <u>Maximum rise of a single step if used in this movement pathway</u>

Aid	Fit no Aid			
Age	90	80	79	69
Rise	125mm	115mm	120mm	135mm

D. <u>Maximum rise and minimum tread length of steps if used in this movement pathway</u>

Aid	Fit no Aid			
Age	90	80	79	69
Rise	65mm	100mm	100mm	115mm
Tread	400mm	600mm	600mm	600mm

Step 5

From the data developed at Step 4 the following design decisions can be made.

Maximum Travel Distance - 90m Horizontal travel
Maximum Ramp Gradient - 1:33 x 7.5m or equivalent
Maximum Ramp Length - 3m x 1:20 or equivalent
Maximum Rise of Single Step - 115mm
Maximum Rise of Step in Stairs - 65mm
Minimum Tread Length in Stairs - 600mm

The Critical Status Charts as illustrated at Step 3 is in practice extended to cover all aspects of design of movement pathways eg surfaces, hand rails, hand grips, etc.

The age of users is entered for various areas of movement and these data, developed as above, are used to determine the critical design data for all destinations and for all movement pathways.

When designing accommodation to be located on undulating or hilly land the design decisions arrived at at Step 5 will clearly show the acceptable distances between accommodation units and shops, public buildings and other community services and will dictate how land should be allocated, how subdivision should be carried out, how site works should be performed and how roads and movement pathways should be designed.

These data sheets and this design technique could, with appropriate adjustments to suit the physical and cultural differences in certain communities, be used to develop local and international standards for the design of the interface for elderly and disabled persons.

One particular advantage of the technique is that it involves documentation of design and design decisions that allows easy checking by funding and approval authorities with respect to conformance with standards or specified requirements.

SPACIAL DESIGN

Where there is a need to consider the manoeuvring space requirement of wheelchair users the "Spacial Design Technique" presented at the 1984 conference in Florida is of special value.

This technique uses an adjustable size model wheelchair and a layout to the same scale to determine the minimum space needs of users with particular size wheelchairs. Alternatively the space needs of any selected percentage of a population can be found by adjusting the size of the model to encompass wheelchairs used by that group.

To obtain the design size of the needed space we add to the minimum sizes determined by use of the model appropriate variation factors that provide for steering errors and clearance to allow use of the facility by persons who lack perfect control of their wheelchairs.

The Spacial Design Technique could be developed into a standard for use in those situations not covered by existing guidelines or standards or where an economical and useful solution is otherwise impossible.

MPAK: RAMPAC AND DECPAC

I have mentioned some problems facing users of the interface. I have suggested a design solution that even if we started today will take several years to establish as a standard and be generally effective in our community.

So what do we do in the meantime. How do we help people cope with their existing built-environment.

There are three products that could be of interest to persons trying to access the various barriers often present in our urban environments.

The first is called MPAK (Multiple Purpose Access Kit). MPAK is a system of prefabricated components that can be easily and quickly assembled on site by two persons without prior site inspection or design detailing. Landings, walkways, ramps and steps, or combinations of these, can be constructed in MPAK to meet particular access needs that will suit most existing building entrance and site situations.

With a suitable range of componentry available ex store and by using the selection chart for standard arrangements, layouts and parts lists, it is possible to complete the construction on site of a typical landing, steps and ramp system in half a day. The system can be adjusted on site as erection progresses to go over or around or to adapt to existing site facilities and surface grades.

The system so erected is safe and useable by disabled persons and will be in general conformance with the requirements of standards such as AS 1428.

The system can, if needed, be partly or fully dismantled and removed, modified, added to or relocated, with minimum cost and with minimum disruption and inconvenience to the site and to occupants at the site.

In Australia we are finding the initial cost of an MPAK system to be about half that of the same facility produced in timber or solid construction. Where MPAK is subsequently used at a second location the cost is a quarter that of solid construction.

MPAK is being manufactured by Acromat Pty Ltd and is on exhibition at this conference.

The second product is RAMPAC (a packable ramp system).

RAMPAC consists of a set of from 2 to 6 ramp sections that clip together to form two runways, for wheelchair use, of length from 500 to 1500mm to allow easy access up or down steps or ledges from 0 to 300mm high.

These ramp sections are light enough for easy handling by elderly persons. When packed, the packed size is such that a full set of 6 sections is about the size of a brief case and easily carried. Ideal for use by couples where one person is confined to a wheelchair or for use by a lone wheelchair operator who has adequate arm reach and hand manipulation capabilities.

Where only low ledges are expected along a movement pathway only one pair of sections need be carried. If high ledges or double steps are expected then two pair or the full set of 6 sections should be carried by hand or on the wheelchair.

The third produce is DECPAC (a folding deck type ramp).

DECPAC consists of a set of triangular elements flexibly connected and foldable for storage and handling purposes.

DECPAC is simply unfolded and positioned over the kerb, or other barrier to progress, and provides a 1.0m wide deck ramp 0.7m long if one section is used, and 1.4m long using two sections and the intermediate support member.

Both RAMPAC and DECPAC are on exhibition at this Conference.

MPAK, RAMPAC and DECPAC are band aid systems for use where the environment has not been adequately designed.

Our aim should be to design proper interfaces that do not need band aid treatment.

REVIEW

I commenced by offering you a challenge. I said that you should ensure that design in the area of the interface is adequate for the needs of users. I stated that this area should be your concern, it is undeveloped and not appropriately covered by existing standards.

I have mentioned the economic benefit of providing a proper interface for use by elderly people. I mentioned some problems with available standards and how we continue to provide facilities that are just not good enough and will in the future be seen by more people as being quite inadequate.

I have shown that it is possible to effectively design the interface for use by elderly people and have mentioned the aged based design data developed for use with the Age Span Design Technique. I have mentioned three products that could help overcome problems in the short term in the existing environment.

The design of the interface will be discussed in greater depth at the World Planning and Housing Congress to be held Sept/Oct 1986 in Adelaide the capital of South Australia.

This will be a major international congress and I encourage those of you who are interested in this field of work to visit Adelaide and attend the congress and the pre congress seminar that will deal specifically with the needs of elderly and disabled persons.

At the Adelaide seminar and congress I will develop the principles of Age Span Design to cover the design of land use, land subdivision, roads and movement pathways with particular emphasis on the access needs of housing developments for elderly and disabled persons.

THE CHALLENGE

It is you - people concerned with the needs of the elderly and disabled - people who have selected to apply their skills in the field of mobility and transportation - who can make the greatest impact.

- You should pay attention to the interface
- You should ensure adequate design standards are available
- You should ensure adherence to such standardd.

As international mobility and transportation experts, you have a responsibility for the interface area: You are leaders in this field, you have the skill and influence to cause local and international standards to be produced. You can and you should act.

Surely, you might say, this interface area is the concern of others with Codes and Standards already avilable for appropriate design in this field.

I put it to you that this is not so. There is a severe lack of appropriate design data for the needs of most interface users. There are standards for only a few minority groups. There are no international standards, or local standards, I know of, that are adequate for the design of the interface and that suit the needs of elderly and disabled persons.

We have major problems in the area of the interface: this problem can be solved: it is an area that should be your concern and responsibility and it is a matter of urgency.

I call on this international conference to take action to establish internationally and at local levels proper guidelines and standards for the design of the interface for use by the elderly and the disabled.

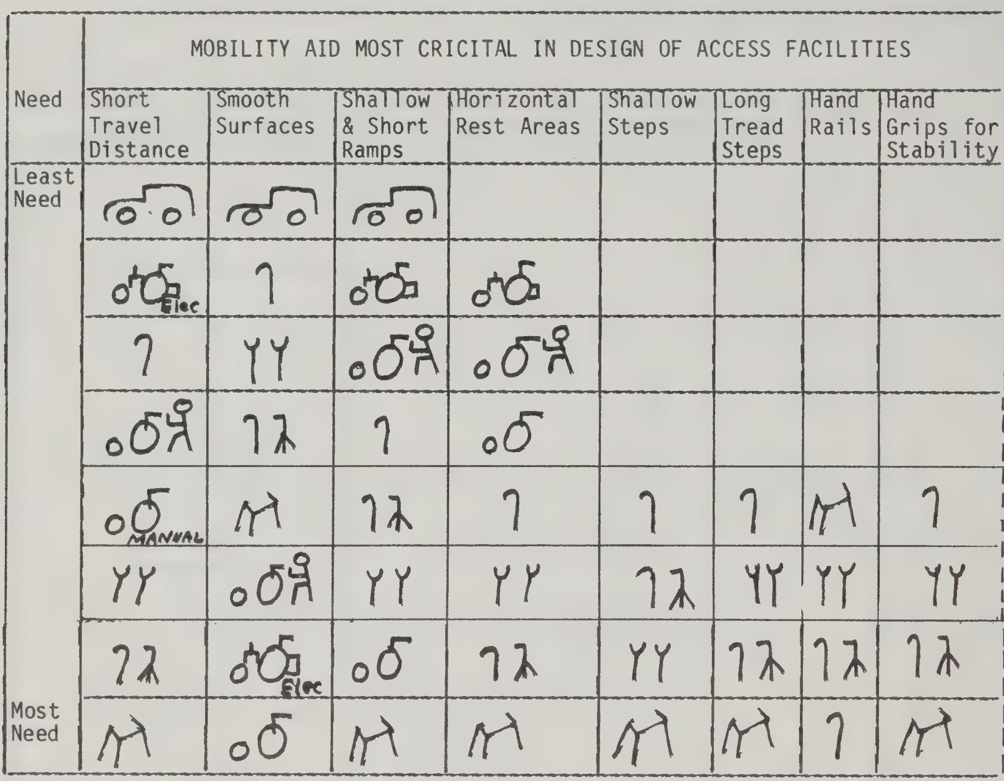
APPENDIX

1. Probability of Disability Chart
2. Critical Status Chart
3. Desired Destinations
4. Used Areas
5. Used Areas - Nursing Home Living
6. Used Areas - Hostel Living
7. Used Areas - Independent Living
8. User Capability Charts
   - 8.1 Fit Aged Person - Acceptable Walking Distance
   - 8.2 Fit Aged Person - Single Step Rise and Stairways
   - 8.3 Fit Aged Person - Incline Length and Grade
   - 8.4 Fit Aged Person - Cross fall to Pavements
   - 8.5 Disabled Aged Person - Acceptable Walking Distance
   - 8.6 Disabled Aged Person - Single Step Rise and Stairways
   - 8.7 Disabled Aged Person - Incline Length and Grade
   - 8.8 Disabled Aged Person - Cross fall to Pavements

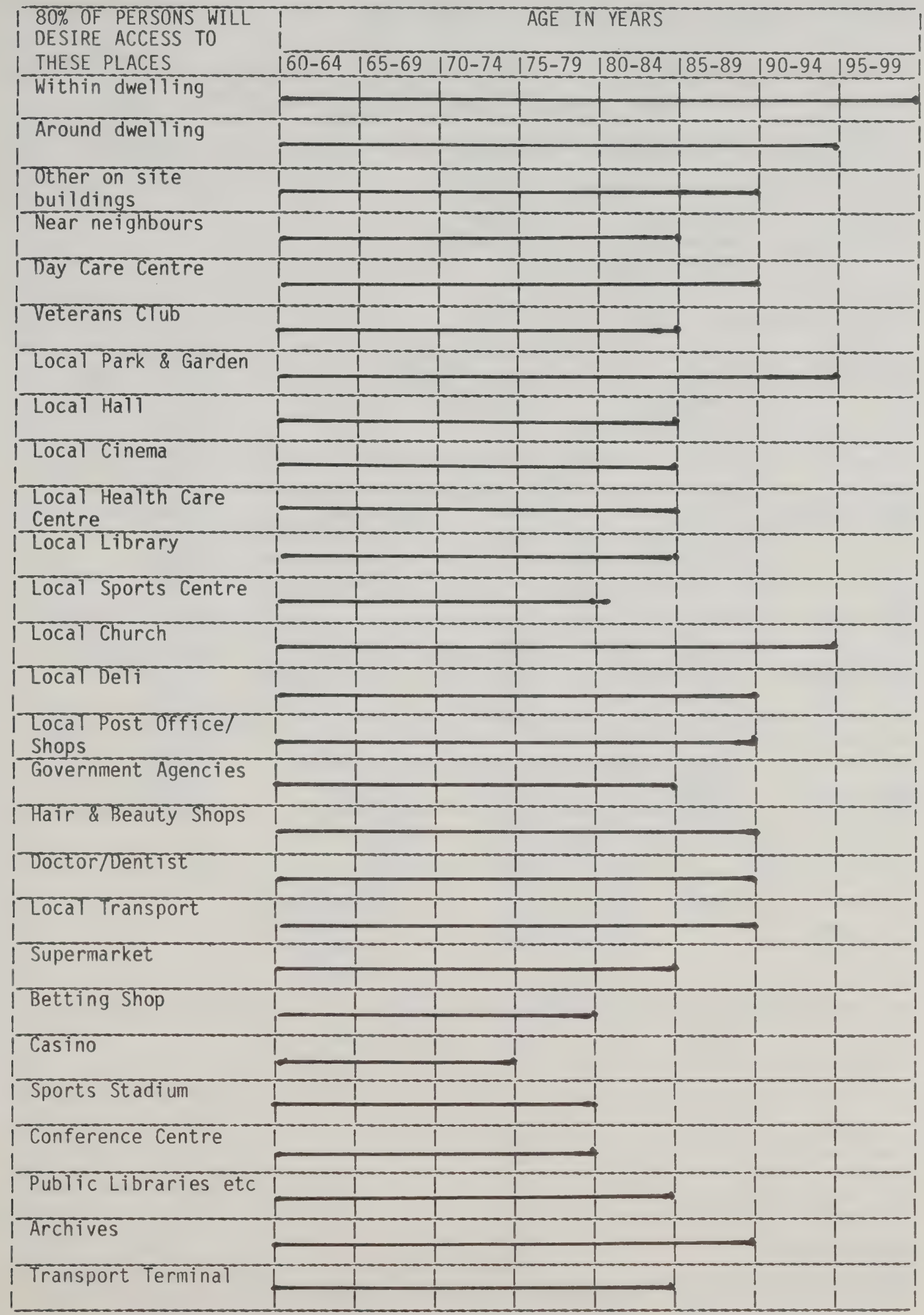
PROBABILITY OF DISABILITY CHART
(Proposed as appropriate for Australian Conditions)

AGE IN YEARS	20% OR MORE PERSONS LIKELY TO HAVE A MOBILITY PROBLEM REQUIRING USE OF THE MOBILITY AID ILLUSTRATED			
	FOR A WEEK OR SO	FOR A MONTH OR SO	PERMANENTLY	USE FOR DESIGN PURPOSES
60 - 64				
65 - 69	or			
70 - 74		or		
75 - 79	MANUAL			or
80 - 84				
85 - 89		Elec.		
90 - 94			Elec.	Elec.
95 - 99				

CRITICAL STATUS CHART
(Proposed as appropriate for Australian Conditions)



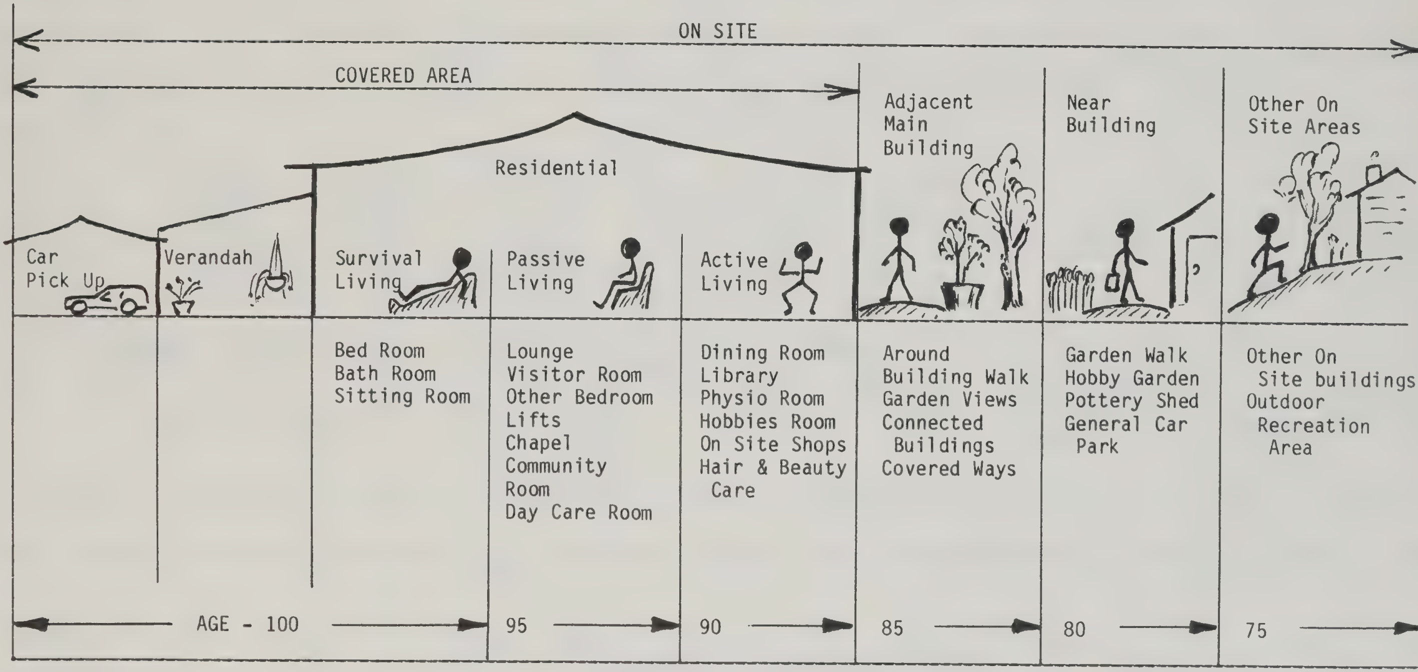
DESIRED DESTINATIONS
(Proposed as appropriate for Australian Conditions)



USED AREAS
(Proposed as appropriate for Australian conditions)

AGE	AREAS REQUIRED TO BE ACCESSIBLE FOR 80% OF PERSONS			
	IN BUILDING	AROUND BUILDING	OTHER PLACES	TRANSPORT
105 and younger	Bedroom Bathroom Dining Room Lounge Room	Verandah Sitting Area		
100 and younger	Kitchen Snack Area Laundry Cleaning Equip	Verandah Potted Plants		On site Car pick up
95 and younger	Kitchen Meal Prep Laundry Cleaning Equip	Near Garden Area	Near Neigh- bour Local Park Other site buildings	Near Road Side pick up
90 and younger	Ironing Room Games Room Hobbies Room	Other Garden Areas	Local Deli Local Club Post Office	Near public Bus Stop
85 and younger	Garden & Tool Shed Craft Area	All site Areas	Local Hall Church Pub Library	Transport Terminal Tourist Sites
80 and younger	Cellar		Supermarkets & other shops & services Beaches	
75 and younger	Attic		Sports Stadium	
70 and younger				
65 and younger				

USED AREAS - NURSING HOME LIVING
(Proposed as appropriate for Australian Conditions)

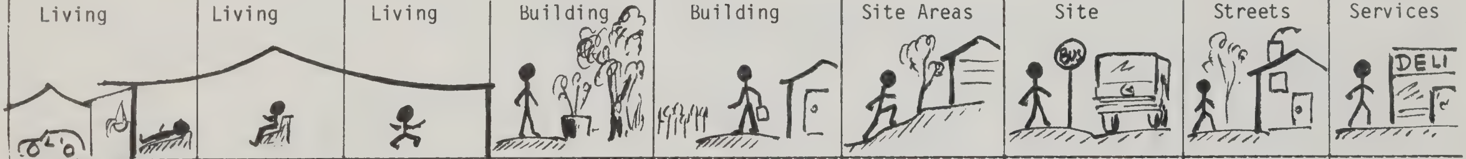


DESIGN AREAS FOR PERSONS AGED AS ABOVE AND YOUNGER

APPENDIX 5

USED AREAS - HOSTEL LIVING
(Proposed as appropriate for Australian Conditions)

APPENDIX 6

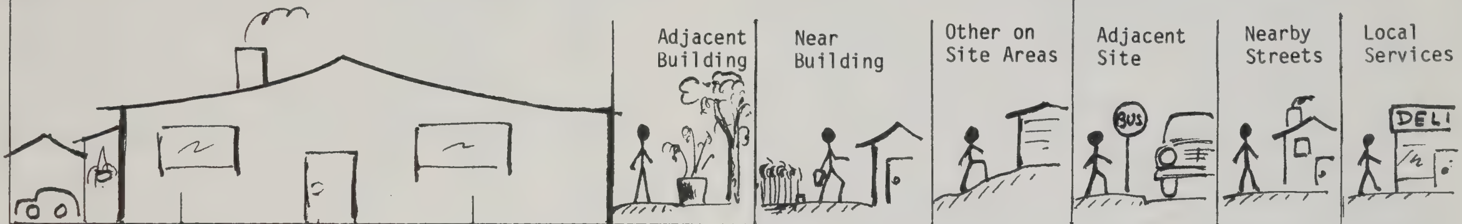


	ON SITE					NEAR SITE		
Survival Living	Passive Living	Active Living	Adjacent Building	Near Building	Other on Site Areas	Adjacent Site	Nearby Streets	Local Services
Bedroom Bathroom Sitting Rm Sunroom Onsite Carpark	Dining Rm Visitor Rm Other Bdrm Day Care Community Room	Library Hobbies Beauty Care Physio Snack Prep Room	Around Bldg Walk Garden Views	Garden Walk Hobbies Gdn Potting Shed Garden Tools Children Play Area	Other on site bldgs Workshops Veg Garden Outdoor Recreation	Roadside Pickup Around site walk	Bustop Local Pk Near Neighbour	Local Deli Chemist Post Off. News Agent Club Bank Church
AGE FIT PERSON →	100 →	95 →	90 →	85 →	80 →	90 →	85 →	80 →
AGE DISABLED PERSONS →	100 →	85 →	80 →	75 →	70 →	80 →	75 →	70 →

DESIGN AREAS TO SUIT PERSONS AGED AS ABOVE AND YOUNGER

USED AREAS - INDEPENDENT LIVING
(Proposed as appropriate for Australian Conditions)

APPENDIX 7



ON SITE							NEAR SITE		
				Adjacent Building	Near Building	Other on Site Areas	Adjacent Site	Nearby Streets	Local Services
Bedroom Bathroom Sitting Room Sun Room Onsite Car Pickup	Snack Prep Linen Selected Medicines Books	Meal Prep Laundry General Medincine	Cleaning Supplies Ironing Hobbies Games	Around Bldg Walk Garden Views Outside Sitting	Garden Walk Hobbies Garden Potting Shed Garden Tools Children Play Area Service Yard	Other on site bldgs Workshops Veg Garden Outdoor Recreation	Roadside Pickup Around site walk	Bustop Local Pk Near Neigh-bours	Local Deli Chemist Newsagent Club Bank Church Doctor Pub Sports Area
AGE FIT PERSON —	100 →	95 →	90 →	100 →	90 →	85 →	95 →	90 →	85 →
AGE DISABLED PERSONS —	95 →	90 →	85 →	90 →	80 →	75 →	85 →	80 →	75 →

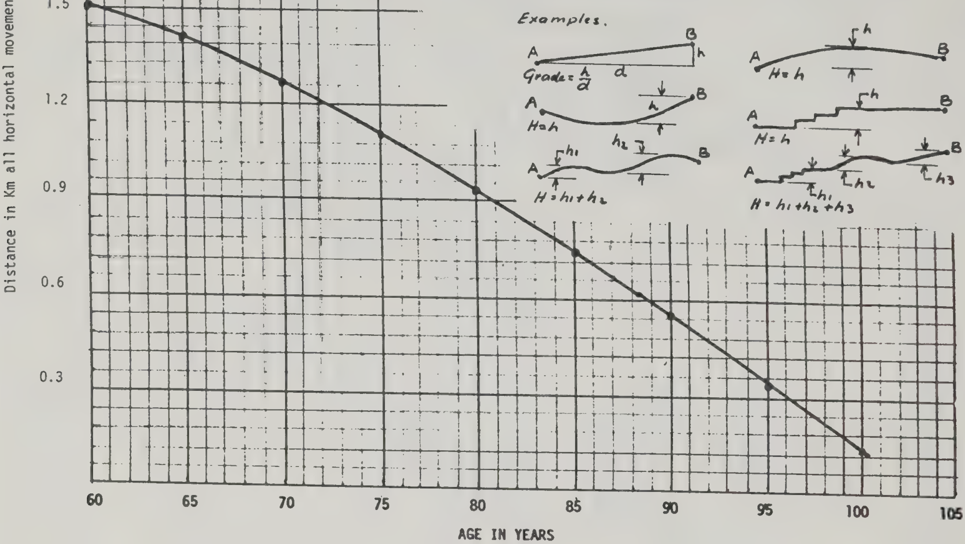
DESIGN AREAS TO SUIT PERSONS AGED AS ABOVE AND YOUNGER

FIT AGED PERSONS
ACCEPTABLE WALKING DISTANCE TO LOCAL SHOPS AND OTHER LOCAL SERVICES

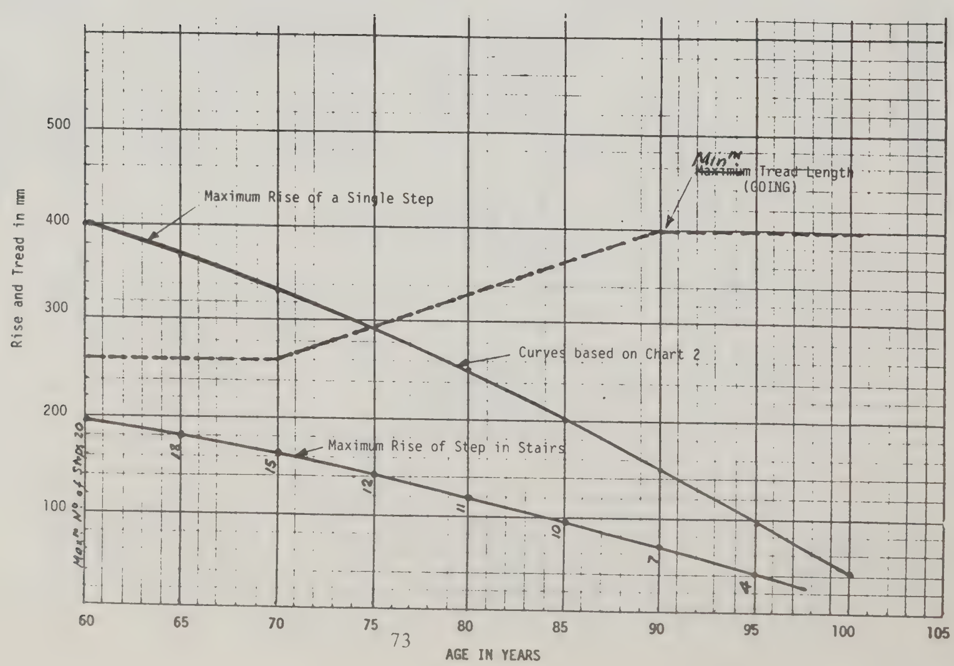
For inclined, stepped or undulating movement pathways the acceptable distance of travel is d where

$$d = \frac{D}{1 + 13.33 \times \text{Grade}}$$ for steady incline or

$d = D - 13.33H$ in all cases, where D is distance obtained from graph below, grade is expressed as a fraction and H is the sum of all rises when travel is in an up-hill direction.



FIT AGED PERSONS
SINGLE STEP RISE AND STAIRWAYS



FIT AGED PERSON

INCLINE LENGTH AND GRADE (RAMPS ETC.)

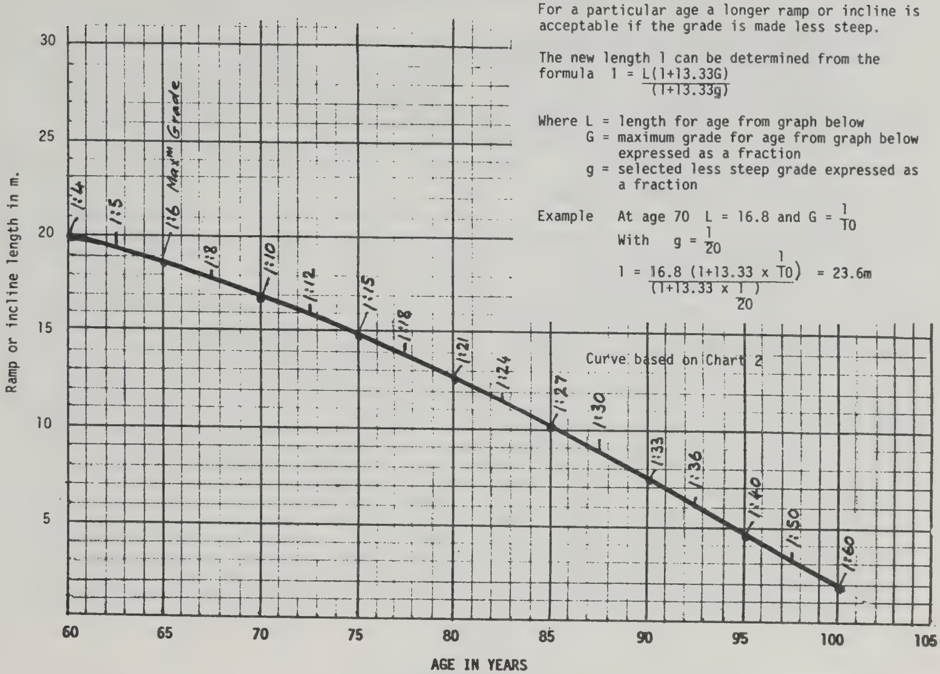
For a particular age a longer ramp or incline is acceptable if the grade is made less steep.

The new length l can be determined from the formula $l = \dfrac{L(1+13.33G)}{(1+13.33g)}$

Where L = length for age from graph below
G = maximum grade for age from graph below expressed as a fraction
g = selected less steep grade expressed as a fraction

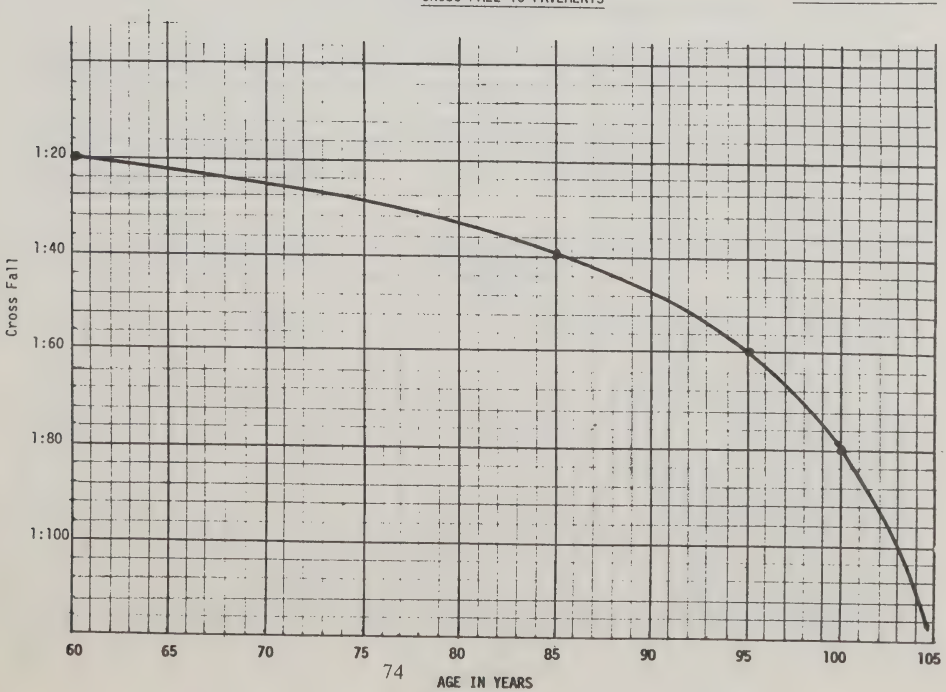
Example At age 70 $L = 16.8$ and $G = \frac{1}{10}$
With $g = \frac{1}{20}$

$$l = \frac{16.8\ (1+13.33 \times \frac{1}{10})}{(1+13.33 \times \frac{1}{20})} = 23.6\text{m}$$



FIT AGED PERSON

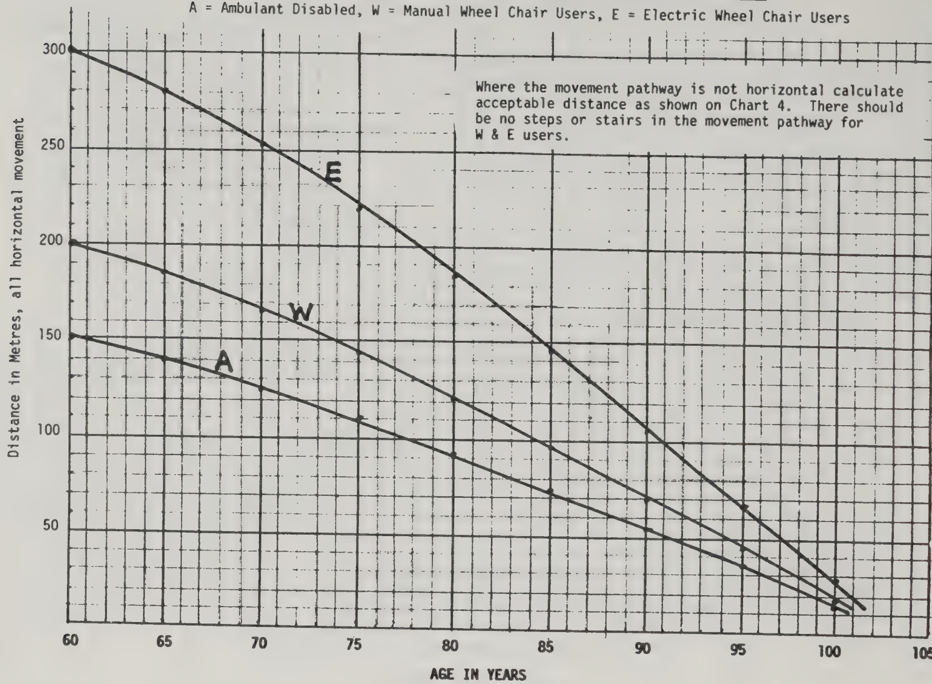
CROSS FALL TO PAVEMENTS



DISABLED AGED PERSONS

ACCEPTABLE TRAVEL DISTANCE TO LOCAL SHOPS AND OTHER LOCAL SERVICES

A = Ambulant Disabled, W = Manual Wheel Chair Users, E = Electric Wheel Chair Users

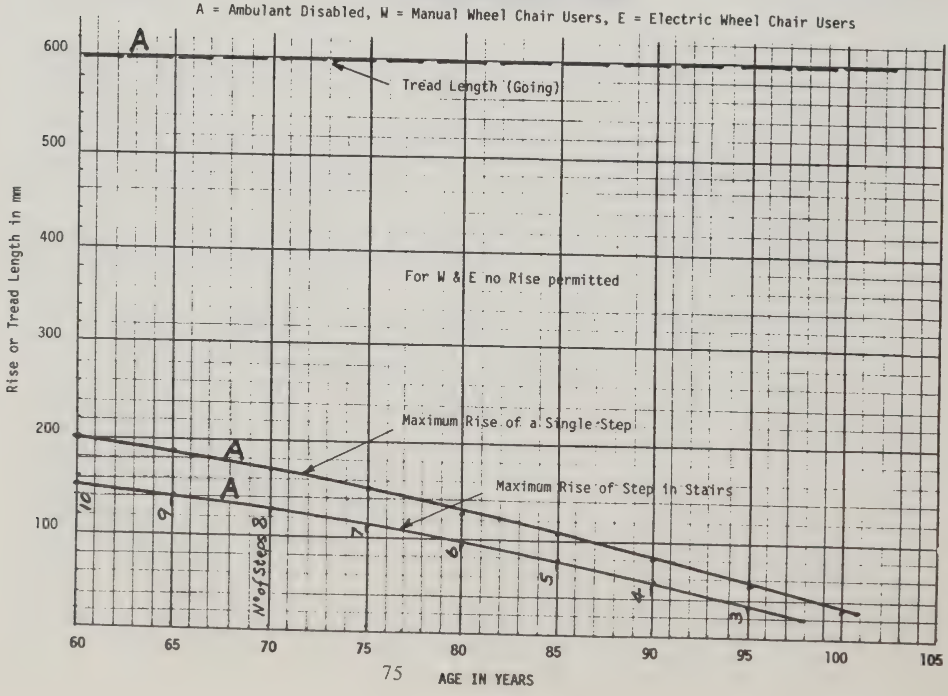


DISABLED AGED PERSONS

SINGLE STEP RISE AND STAIRWAYS

APPENDIX 8.6

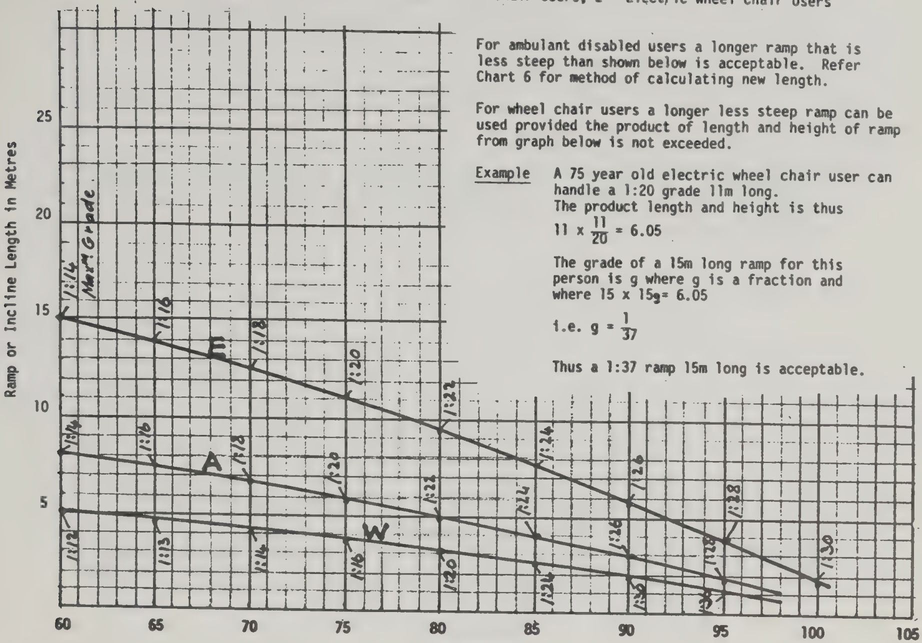
A = Ambulant Disabled, W = Manual Wheel Chair Users, E = Electric Wheel Chair Users



DISABLED AGED PERSONS

INCLINE LENGTH AND GRADE (RAMPS ETC.)

A = Ambulant Disabled, W = Manual Wheel Chair Users, E = Electric Wheel Chair Users



For ambulant disabled users a longer ramp that is less steep than shown below is acceptable. Refer Chart 6 for method of calculating new length.

For wheel chair users a longer less steep ramp can be used provided the product of length and height of ramp from graph below is not exceeded.

Example A 75 year old electric wheel chair user can handle a 1:20 grade 11m long. The product length and height is thus

$11 \times \frac{11}{20} = 6.05$

The grade of a 15m long ramp for this person is g where g is a fraction and where $15 \times 15g = 6.05$

i.e. $g = \frac{1}{37}$

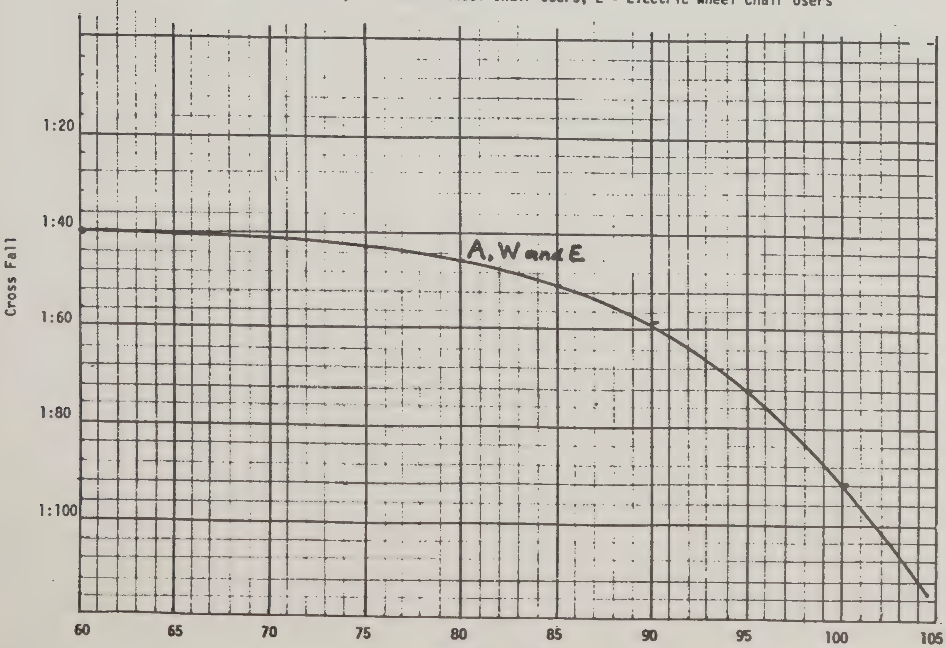
Thus a 1:37 ramp 15m long is acceptable.

AGE IN YEARS

DISABLED AGED PERSONS

CROSS FALL TO PAVEMENTS

A = Ambulant Disabled, W = Manual Wheel Chair Users, E = Electric Wheel Chair Users



 AGE IN YEARS

PROBLEMS ON MOBILITY AND TRANSPORT FOR ELDERLY AND DISABLED PERSONS IN THE FEDERAL REPUBLIC OF GERMANY

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1. Target Definiton

For planning and design data are needed, which are really relevant for the parameter of planning. Therefore, the requests included a demand not only for data of diagnostic groups rather than of requirement groups. So, the Federal Minister of Transport used a national representative survey conducted jointly with the Federal Minister of Labour and Social Affairs and for Youth, Family Affairs and Health to obtain more detailed information regarding mobility handicaps. Because this question assumes central importance in the spectrum of the individual needs and situation-specific deficits of handicapped persons.

2. Tasks and Study Concept

The present project may be defined as having the following tasks:

- Analysis of the overall structure of the mobility-handicapped population according to target groups with like or similar needs.
- Description of the quantitative importance of the several target groups.
- Identification of the general out-of-home mobility or immobility as compared to the non-handicapped population.
- Description of infrastructural mobility barriers.

A multi-stage study design comprising an interactive approach was developed for the empirical determination of the handicapped:

- To begin with, a representative household survey conducted on a national scale was used to identify interviewees who were positively not handicapped (preliminary survey).
- An in-depth main survey was carried out in the case of all other persons to corroborate or discard a suspected handicap. This was done mainly by ascertain any handicap-specific need in important spheres of life.
- Finally, the kind and frequency of out-of-home activities were established for a sub-group of the handicapped thus ascertained and for a control group of non-handicapped persons as of a set date.

Slightly under 67,000 persons (gross number) were included in the preliminary survey, the return rate being 70%. From this population, 10,000 persons were selected for the main survey, in which a return rate of 84% was achieved. Finally, the mobility survey comprised 2,900 handicapped persons, with 2,300 household members and, in addition, 2,400 persons in control households; in this case the return rate totalled 83%.

The main study permits a grossing up of the results to 6.98 million Germans aged 18 and older and living at home who are to be classified as handicapped (i.e. 15.7% of the German residential population in this age group); in addition, there are 0.34 million handicapped young people aged 6-18 years (3.6%) and 0.14 million handicapped children less than 6 years old (4.4%). Three quarters of the handicapped adults were officially recognised, slightly under three fifths were also mobility handicapped.

3. The Classification and Description of the Mobility Handicapped

The classification of the mobility handicapped was carried out by means of seven dimensions:

- o Dependence on companion,
- o dependence on technical aids,
- o ability to use means of transport,
- o difficulty in overcoming structural barriers,
- o ability to carry out various out-of-home activities,
- o sense of insecurity in traffic,
- o mobility-relevant (serious) physical disablement.

These dimensions were concentrated by means of frequency distributions and were transferred into a correlation matrix. The correlation values showed that some of the dimension-controlling variables were redundant on account of their overlaps, so that it was possible to restrict the classification to five groups:

I = Basically immobile persons who are confined to bed and cannot normally leave their homes.

BuT = Persons who basically need a companion and technical aids, i.e. wheelchair users and persons who despite crutches, stick etc. depend on human assistance at least for leaving their homes.

B = Persons who need (only) companion, i.e. no technical aid but human assistance.

T = Persons who can do without a companion but are dependent on technical aids.

H = Persons who, while not needing help, encounter difficulties involving structural obstacles e.g. in (public)transport and on the road (steps, doors, escalatores, gradients, etc.).

Using the criteria mentioned, the study established a mobility handicap in the case of 5.29 million Germans living at home and aged 18 years and older; this figure represents 11.9% of the relevant basic population. Only 61% of this group were officially recognised as handicapped, only 40% were entitled to use public transport free of charge. A breakdown according to the five groups produced the following distribution:

o	Group I	=	5.2%	(0.28 million)
o	Group BuT	=	11.6%	(0.61 million)
o	Group T	=	24.8%	(1.31 million)
o	Group T	=	13.5%	(0.71 million)
o	Group H	=	44.9%	(2.38 million)
TOTAL		=	100.0%	(5.29 million)

Almost one mobility handicapped person in two suffers from severe functional impairments or amputations of one or both leg(s), one in three has problems involving his vertebral column, one in nine is deaf or hard of hearing, one in twenty is blind or suffers from severely impaired vision.

Within the group of the mobility handicapped the proportion of the sexes is represented in about the same manner as in the case of all handicapped persons (men:women = 1:2). Only group T constitutes an exception, the cause presumably being a higher percentage of war invalids but mainly the more intensive endeavours by men to preserve, for some time, and within certain limits, their employability and thus also the possibility of out-of-home mobility by the use of technical aids (Table 1).

The average age of the mobility handicapped goes up throughout from group H to group I. In a simplified way it can be said that every other member of group H is below 65 years of age, (well) over one in two in group T between 50 and 75 years, one in two of group B between 65 and 80 years, (almost) one in two of group BuT over 75 years and (slightly less than) one in two of group I over 80 years of age.

Hence it may be concluded, again in a simplified manner, that with increasing age a number of members of group H will transfer to group B, from group T to group BuT and from group B to group I (Table 2).

The household size of the several groups of mobility handicapped varies considerably. The relatively large households in group I, where only handicapped persons living at home are examined, can easily be explained in terms of the special situation of the persons concerned; as a rule, the necessary care and attendance calls for a bigger family unit.

Conversely, the family sizes in groups BuT and B are appallingly small. The high percentage of one-person households (51 and 47% respectively) must be seen above all against the background of the need for accompaniment. Only in group H is the household size still (slightly) greater than the overall

average. In return, however, the number of mobility-handicapped persons per household goes up proportionally (Table 3)

Of course, the household structure also correspondents to the family status of the persons concerned; high percentages of widow(er)s in groups BuT and B are mainly responsible for the small household sizes (Table 4).

4. Implementing out-of-home Activities

Naturally, the mobility handicapped encounter a number of specific difficulties when moving about out of the home. Longer walks imply particularly grave problems. Almost two out of three (60%) mobility-handicapped persons encounter difficulties in coping with them. This aspect is of special importance because the "transport mode" on foot is used most frequently by almost all groups of handicapped persons for the purpose of out-of-home mobility. About one out of four mobility-handicapped persons has problems when crossing streets (28%) or feels handicapped on account of general weakness (25%); in this context one out of five (21%) mentions frequent stumbling as a special aggravation. On the other hand, problems involved in keeping one's bearings, as mentioned in one case in seven (14%), suggested that a mobility handicap is not only a matter of motory weakness and/or functional impairments (Table 5).

In addition, all mobility-handicapped persons sometimes have considerable difficulties in coping with constructional obstaces. Stairs (escalators, slopes) are by far the most important ones. On the other hand, kerbs, thresholds and steps are a somewhat less serious obstacle, which develops an above-average barrier effect only in the case of group BuT. Finally the fact that the opening and closing of doors is often mentioned in group BuT should be seen in conjunction with the more frequent occurence of functional impairments of arms/hands in this group.

Groups BuT and B by definition comprise all those mobility-handicapped persons who (really) ought to be accompanied during their out-of-home mobility. In two of three cases this can be granted by a companion; in the case of longer trips/journeys a special transport service is really required, clearly more frequently so as far as group BuT is concerned. These aids are not always available and certain journeys simply have to be carried out nevertheless. This has already been discussed in a similar context and must be taken into consideration as a specific feature when analysing the behaviour of handicapped persons (Table 6).

The mobility handicapped who use technical aids or depend on such aids for their out-of-home mobility are also put together into two groups (BuT and T). Crutches/arm support take first place on both groups (54 and 50% respectively). The need for a walking stick is as frequent as that for a walking frame/wheelchair. While in (the less severe) group T a walking stick is required more frequently (42 as against 25%),

a walking frame/wheelchair is required more often in (the severe) group BuT (35 as against 12%). The resulting percentage of 7% of the mobility handicapped who use a walking frame or a wheelchair is broken down between these two facilities at a ratio of one to three. Hence an absolute number of about 320,000 wheelchair users (living at home) of German nationality (aged 18 years and older) may be calculated (Table 6).

5. Mobility of the Mobility Handicapped - A Comparison

However, a quasi immanent analysis of handicapped persons only does not yet provide sufficient information concerning the nature and scope of activities which can no longer or no longer completely be carried out, owning to the handicap. Since, moreover, handicapped persons, as a rule, clearly differ from the overall population with regard to their socio-demographic structure, and since the socio-demographic structure in turn substantially influences the organisation of out-of-home activities, such comparisons demands a population of so-called control persons. These control persons must be selected in such a way that they dublicate as precisely as possible the socio-demographic structure of the group of handicapped persons concerned. The comparison of the (out-of-home) mobility of the mobility handicapped with that of the selected control persons then makes it possible to estimate the mobility deficits on the mobility-handicapped persons.

On an average weekday, 60% of the mobility handicapped leave their home at least once. This value is about one quarter lower than that of the non-mobility handicapped but - as the corresponding value of the control persons shows - it is mostly attributable to the different socio-demographic structure and less so to the mobility handicap.

If the home is left at all on a specific day, more than one outing is made in every other case; this results in 1.53 outings a day per mobile person among the mobility handicapped. This figure is higher than the one for the control person and attains almost the one for the remaining population. Since leaving the home constitutes a central mobility barrier for almost all handicapped persons; it may be concluded that when conditions are favourable (availability of a companion, good physical shape at the time, etc.) an effort is made to complete the most comprehensive programme possible, not least for the purpose of compensating deficits which arise when these conditions do not exist. Because, related to all persons, the number of outings continues to remain below the comparative values (Table 7).

This trend is also found when trip frequencies are compared. Here it is likewise revealed that the number of trips per person is lowest amongst the mobility handicapped, but when they become mobile they develop greater activities than the control persons. This finding is also borne out, although in a less marked way, by the number of trips per outing (Table 7).

The number of activities performed out of home cannot be surprising. It is higher, among the mobile mobility handicapped, but lower among all mobility handicapped, than among the corresponding control persons. The constraint becomes obvious once again under which the mobility handicapped (must) organise their (rare) out-of-home mobility: they total 0.83 supply activities per mobile person, a value that clearly exceeds not only that of the control person but above all also that of the non-mobility handicapped. However, this is barely sufficient to attain the "basic supply level" of 0.5 shopping activities per person and day, which is almost constant for all three groups. Similar findings are also true concerning leisure-time and recreational activities, although the control person fall off slightly in this respect (Table 7).

The average trip duration of the control person is slightly less than one tenth higher than that of the non-mobility handicapped, which is related inter alia to the use of transport modes. This value again is slightly exceeded by the the mobility handicapped. Hence we may calculate the comparatively long participation in traffic of one and a half hours per mobile mobility-handicapped person. This contrasts with a clearly shorter average time per activity. Consequently, the mobility handicapped take more time to carrying out the activities concerned; both effects may be associated with the handicap (Table 8).

Based on the duration of the participation in traffic and the duration of out-of-home activities, an out-of-home time of four hours and forty minutes per mobile handicapped person may be calculated. The corresponding value on the part of the control persons is three quarters of an hour higher; this is exclusively caused by the different dwell times at destinations.

For all mobility handicapped persons, i.e. including those who were not mobile on the relevant day, this results in an average time at home of more than 21 hours per day. The generally high percentage of times at home (even the non mobility handicapped spend a daily average of 18.6 hours at home) may be accounted for by the fact that the average values cover all persons, that is to say also for example those who are not gainfully employed, and all days of the week (including weekends, holidays, times of illness etc.).

The duration of the participation in traffic especially of the mobile mobility-handicapped persons differs only slightly from the control group, and for all mobility-handicapped persons it is slightly under one hour. Almost two hours are spent at destinations out of home. The times spent at home are clearly shorter in the case of both control groups. The times spent on supply and leisure-time activities are almost identical in all three groups; the corresponding durations of participation in traffic differ only slightly. Consequently, mobility-handicapped persons hardly participate less in (Table 8).

Shopping and supply trips take first place both for the mobility handicapped and for the control persons, followed (immediately) by trips permitting recreational activities. The frequencies of the other trip purposes are orientated to the socio-demographic structures. Service trips, i.e. trips on which third persons are/must be accompanied, naturally occur more frequently with the non-mobility handicapped. Anyway, this trip purpose, too, is a component of the activity programme of the mobility handicapped, albeit a minor one. This indicates that in households in which several mobility-handicapped persons live, a "less" handicapped person has to accompany a more severely handicapped one now and then (Table 9).

Among the mainly used modes, walking clearly takes the first place as a "means of transport" for the mobility handicapped. This predominance is above all brought about at the expense of using a car as a driver. On the other hand, riding in a car as a passenger is a mode used comparatively more frequently among the mobility handicapped, and that both regarding cars owned by the household and others. Public transport, too, is used more often by the mobility handicapped, relatively speaking even twice as often as by the non-mobility handicapped. In a greatly simplified manner the relationship of the frequency of trips for which the car is used as a driver by the three groups under consideration here is found to be 4:3:2 (non-mobility handicapped persons: control persons: mobility-handicapped persons), which is largely compensated for by a reverse relationship (2:3:4) in the case of walks and trips by public transport.

Trip-making on foot is the absolutely predominant form of participation in traffic by the mobility handicapped. This is followed by trips made as a driver and by public transport; the former come up to slightly under one half, the latter to approximately one third of the frequency of walks. The high percentage of passengers results in a correspondingly high occupancy rate of the cars which are used by mobility-handicapped persons (Table 10).

The average trip durations are highest amongst the mobility handicapped. This is mainly attributable to the (slightly) longer duration of walks and trips by public transport. Both effects are associated with the mobility handicap. The duration of trips made as a passenger is longer when a car is involved that does not belong to the household; arrangements of this kind are presumably made rather for longer journeys. On the other hand, rides in a car owned by the household are clearly shorter. For the mobility handicapped, this form of transport is abviously required more often even for short trips. This is even more obvious as far as trips per taxi are concerned.

The use of public transport by (mobility) handicapped persons assumes a central rôle particulary with a view to socio-political aspects.

One out of four mobile mobility-handicapped persons uses at least one means of public transport per day. This value is clearly higher than the comparative ones (20% for control persons and 15% for non-mobility handicapped persons). Owing to the more frequent use of several means of public transport during one journey (on average 1.35 rides on public transport per trip), public transport accounts for 22% of all modes used by the mobility handicapped. The corresponding value for the control persons is more than one quarter lower, than of the non-mobility handicapped more than one half lower (16 and 10%, respectively). It is true that when all persons are considered, these differences tend to level off because of the lower trip frequency of the mobility handicapped; nevertheless, public transport maintains a much greater importance than for the other two groups.

Of all the means of transport used, the bus clearly assumes a special position. It is used most frequently, both on the whole and in combination with other modes. The reasons behind this are the absence of railbound transport in many communities and also the paramount feeder function of buses where such rail-bound transport exists.

6. Summary

As far as the Federal Republic of Germany is concerned, this is the first time that comprehensive, well-founded data have become available concerning the number, situation an mobility of the (mobility) handicapped. Thus an important information gap in the area of planning for the handicapped has been closed. It was possible to demonstrate and quantitatively to corroborate substantial effects of the handicap on the management of the day-to-day course of life.

Table 1

Socio-demography	Mobility-handicapped Germans (aged 18 years and older)					
	Mobility-handicapped persons in group:					
	total	I	BuT	B	T	H
sex	%	%	%	%	%	%
– male	36	32	30	34	53	35
– female	64	68	70	66	47	65
total	100	100	100	100	100	100

Table 2

Socio-demography	Mobility-handicapped Germans (aged 18 years and older)					
	Mobility-handicapped persons in group:					
	total	I	BuT	B	T	H
age group	%	%	%	%	%	%
– 18 to 50 years	13	10	8	11	14	16
– 51 to 65 years	26	11	18	15	31	33
– 66 to 75 years	29	22	28	29	26	32
– 76 to 80 years	16	14	22	21	18	11
– 81 years and older	16	43	24	24	11	8
total	100	100	100	100	100	100

Table 3

Household size	Mobility-handicapped Germans (aged 18 years and older)					
	Mobility-handicapped persons in group:					
	total	I	BuT	B	T	H
household size	%	%	%	%	%	%
– one-person household	40	28	51	47	44	33
– two-person household	35	34	36	32	28	40
– household comprising three or more persons	25	38	13	21	28	27
total	100	100	100	100	100	100
composition of the household						
– average household size (all persons)	2.01	3.18	1.68	1.85	1.97	2.08
– average number of mobility-handicapped persons (aged 18 years and older)	1.12	1.07	1.11	1.08	1.06	1.17
– percentage of mobility-handicapped persons (aged 18 years and	56 %	34 %	66 %	58 %	54 %	56 %

Table 4

Socio-demography	Mobility-handicapped Germans (aged 18 years and older)					
	Mobility-handicapped persons in group:					
	total	I	BuT	B	T	H
family status	%	%	%	%	%	%
– single	10	7	10	11	11	7
– married	54	44	47	47	57	62
– widowed	33	48	41	39	29	28
– divorced	3	1	2	3	3	3
total	100	100	100	100	100	100

Table 5

Difficulties out of home	Mobility-handicapped Germans (aged 18 years and older)					
	Mobility-handicapped persons in group:					
	total	I *)	BuT	B	T	H
problems involving	%	%	%	%	%	%
– kerbs, – thresholds	30		49	30	29	21
– stairs	46		57	42	39	53
– doors	9		28	8	6	5
difficulties						
– when going for longer walks	60		81	63	62	52
– when crossing (streets)	28		57	40	20	15
– because of general weakness	25		37	36	18	20
– becaus of fre-qent stumbling	21		36	28	18	17
– involving the sense or orien-tation	14		26	22	7	7

*) not applicable

Table 6

Mobility aids	Mobility-handicapped Germans (aged 18 years and older)					
	Mobility-handicapped persons in group:					
	total	I *)	BuT	B	T	H
technical aids	%	%	%	%	%	%
– walking stick	9		25	–	42	–
– crutch(es)	14		54	–	50	–
– walking frame/ wheelchair	7		35	–	12	–
accompaniment						
– companion	27		62	68	–	–
– transport service (on longer trips)	21		70	52	–	–

*) not applicable

Table 7

Indices – out-of-home activities	Germans aged 18 years and older: all persons – total (not mobility handi-capped)	control persons	mobility-handicapped persons	mobile persons – total (not mobility handi-capped)	control persons	mobility-handicapped persons
out-of-home percentage	75.8 %	66.5 %	60.4 %	*)	*)	*)
out-of-home activities	1.68	1.22	1.16	2.21	1.84	1.91
– work	0.42	0.19	0.09	0.55	0.29	0.15
– supplies	0.49	0.50	0.50	0.64	0.75	0.82
– leisure time	0.50	0.41	0.50	0.66	0.62	0.83
– others	0.27	0.12	0.07	0.36	0.18	0.11
outings	1.20	1.00	0.92	1.58	1.50	1.53
trips	2.87	2.22	2.08	3.79	3.34	3.44
trips per outing	**)	**)	**)	2.40	2.23	2.25

*) not applicable because by definition 100 % for mobile persons
**) not applicable because immobile persons covered, too

Table 8

Indices – time budget	Germans aged 18 years and older: all persons – total (not mobility handi-capped)	control persons	mobility-handicapped persons	mobile persons – total (not mobility handi-capped)	control persons	mobility-handicapped persons
duration per trip *)	**)	**)	**)	23.9	26.1	26.3
duration of participation in traffic *)	69	58	55	91	87	91
duration per activitiy *)	**)	**)	**)	152	129	99
time spent out of home *)	323	216	169	427	324	280
time spent at home	18h 36'	20h 24'	21h 11'	16h 53'	18h 36'	19h 20'
time spent on out-of-home activities	4h 15'	2h 38'	1h 54'	5h 36'	3h 57'	3h 9'
– work	2h 15'	1h 6'	31'	2h 58'	1h 39'	51'
– supplies	26'	28'	28'	34'	43'	47'
– leisure time	1h 2'	52'	51'	1h 22'	1h 18'	1h 24'
– others	32'	12'	4'	42'	17'	7'
time spent in traffic	1h 9'	58'	55'	1h 31'	1h 27'	1h 31'

*) expressed in minutes
**) not applicable because immobile persons covered, too

Table 9

Trips to out-of-home activities	Germans aged 18 years and older					
	all persons			mobile persons		
	total (not mobility handi-capped)	control persons	mobility-handicapped persons	total (not mobility handi-capped)	control persons	mobility-handicapped persons
	abs.	abs.	abs.	%	%	%
work	0.99	0.50	0.23	34	22	11
training/education	0.11	0.02	0.01	4	1	0 *)
supplies	0.82	0.93	0.91	28	42	44
leisure times	0.76	0.67	0.87	27	30	42
service	0.07	0.04	0.02	3	2	1
others	0.12	0.06	0.04	4	3	2
total	2.87	2.22	2.08	100	100	100

*) less than 0.5 %

Table 10

Mainly used transport mode (MTM)	Germans aged 18 years and older					
	all persons			mobile persons		
	total (not mobility handi-capped)	control persons	mobility-handicapped persons	total (not mobility handi-capped)	control persons	mobility-handicapped persons
	abs.	abs.	abs.	%	%	%
on foot	0.69	0.79	0.94	24	36	45
pedal cycle	0.24	0.16	0.12	9	7	6
motorised bicycles	0.05	0.02	0.01	2	1	0
car used as a driver	1.30	0.71	0.40	45	32	19
passenger (in car owned by household)	0.17	0.12	0.14	6	6	7
passenger (in car not owned by household)	0.09	0.06	0.08	3	3	4
local and regional public transport	0.23	0.28	0.33	8	12	16
taxi	0.01	0.01	0.02	0	0	1
railway	0.04	0.03	0.02	1	1	1
others (e.g. lorry, ferry)	0.05	0.04	0.02	2	2	1
total	2.87	2.22	2.08	100	100	100
occupancy of car used				1.20	1.26	1.54

ASPECTS OF THE TRANSPORTATION PROBLEMS OF ELDERLY AND HANDICAPPED PERSONS IN DEVELOPING COUNTRIES

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ASPECTS OF THE TRANSPORTATION PROBLEMS OF ELDERLY & DISABLED PERSONS IN DEVELOPING COUNTRIES

By

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PURPOSE AND METHOD

This paper reviews aspects of the transportation situation of the elderly and, to a limited extent, of the disabled population in developing countries. The purpose of the review is to help concerned parties better understand the nature and extent of the problem, and the requirements of appropriate public policy necessary to meet the special transportation needs of this segment of the population in developing countries. The method of the paper is essentially that of comparison of relevant data from developed and underdeveloped countries. A review of the situation in Israel is used to illustrate, in case study style, existing policy, and lack of policy, in a less developed country.

The most frequent cross-national studies in the field of transportation are those whose aim is understanding the relevant evolutionary progression of transportation development. Such understanding has served in the development of programs for acceleration of economic progress in developing nations through the application of the correct type, amount and timing of transport investment (Owen, 1966).

Also common are international studies of traffic accident data. These have been carried out for many years (Smeed, 1953), in order to better understand what might be inherent in the accident problem as compared to that which is environmentally based. The studies have had a direct impact on accident programming and have led to concentration on environmental manipulation as the most effective means for reducing accident rates in developing countries.

In their cross-national study of services for the developmentally disabled (Bryan, Reiter and Newman, 1985) have written that :

> "Because of different embedded cultural assumptions in different countries, successful methods and technologies from one country cannot automatically serve as models for another country unless the two countries share similar values, beliefs, attitudes, resources, demographies and so on. Furthermore, one may find that there are other means of addressing the same problem in another culture to which neither country was fully aware, since a particular approach was taken for granted as the 'normal' way to do things."

'Normal' expectation in transportation might be, for example, that a new road will lead to economic advantage as a result of faster transport of products to market. Owen,(1966) describes two roads built in North Borneo, one of which was used as 'expected.' The second was not used "because people refused to alter a satisfying way of life based on cattle raising and subsistence farming. Marketing of livestock was not undertaken because the number of cattle owned was an index of social standing."

Transport policy may be defined as the use of legislation, public finance and other instruments to influence the way in which goods are moved and people travel. Establishing transport policy for the elderly and handicapped in developing countries requires, therefore, identification of policy relevant factors and their consideration in respect to the complex range of problems facing these countries.

The task of finding solutions to the transport and mobility problems of the aged and handicapped in developing countries is especially difficult because of the need to adopt policies and means which are technologically fitting and culturally both appropriate and acceptable. This is particuarly important in respect to defining and quantifying the mobility needs of the elderly and handicapped in these societies.

FACTORS AFFECTING THE NEED FOR SPECIAL TRANSPORT: Some Comparisons Between Developed & Less Developed Countries

Bell and Revis (1984) have considered the following factors as especially relevant to a reappraisal of policy direction for specialized transport in the United States in the second half of the 1980's:
1) Growth in number and change in structure of the elderly population;
2) The geographic distribution of the elderly population; 3) The male to female ratio in the population; 4) Economic status and income level; 5) Employment and retirement; 6) Educational level; 7) General national development ; inflation, energy, funding limitations for special programs, etc.

Appraisal of the need for special transportation in developing countries necessarily involves consideration of these same factors, as well as examination of travel characteristics, the availability of different transport modes, the vehicles used in the public transport sector, and relevant socio-cultural custom and tradition.

Income Level and Car Ownership

In quantitative terms, there is no better way to classify a country as "developed" or "less developed" than by its ranking on a scale of per capita income. Thus, the more underdeveloped countries may have a per capita income of as low as \$ 300.- to \$ 500.- per year, while in the more developed countries, the figure is in the order of \$ 8,000.- and over.

For understanding transportation issues, the significant aspect of the variation in per capita income is its high correlation with the rate of motorization, i.e., with the number of motor vehicles per capita. This correlation has been found to hold not only when countries are considered, but when income levels and motorization are examined for cities (Zahavi, 1976, see Table 1).

Table 1: Motorization vs. Income in Selected Cities, 1970

City	Motorization	Annual Income ($)
San Jose	4.8	430
Abidjan	7.6	500
Bangkok	5.0	525
Kuala Lumpur	5.2	660
Bogota	2.2	760
Singapore	7.3	1,100
Mexico City	7.8	1,225
Caracas	9.1	1,600
London	22.2	2,550
Paris	24.8	3,530
Washington, D.C.	31.6	5,390

Many older persons alive in developed countries today have never owned cars or become drivers (Hopkin, Robson, Town, 1978). Obviously, older persons in underdeveloped countries, where the rate of motorization is even now extremely low, can be expected to have almost no access as an owner-driver to a private motor vehicle. Furthermore, despite larger average family size, very low motorization still means that most families do not have access to a vehicle. For example:

Developed country	-	300 cars/1,000 persons at an average family size of 3 1/3rd persons is equivalent to 100 cars per 100 families;
Less developed country	-	60 cars/1,000 persons at an average family size of 6½ persons is equivalent to 39 cars/100 families.

Travel Characteristics

Given the fact of lower per capita income and the accompanying low car ownership -- among other cultural, social, and land use related influences -- the travel habits in the urban areas of less developed countries compared to developed countries are characterized by: (Mogridge, 1979; Maunder, 1983; Eastman and Pickering, 1981).

1. Less total trips per person per day -- about 1/3rd less;
2. More walk, cycle and public transport trips;
3. Less private car trips;
4. Less social-recreational trips.

The description by Mogridge (1975) of the results of a travel survey in Nairobi, Kenya (at a time when motorization in the city was 90 cars/1,000 people) summarizes the situation in the less developed countries quite succintly:

> " ... it became clear that whereas in many developed countries there is a real modal choice for car owners ... in Nairobi, car owners tend to make <u>all</u> trips by car, while non car owners make the choice between walk mode and public transport .. (resulting in) a very substantial proportion of walk trips exceed(ing) two miles in length ... <u>The data also reveal that as income and car ownership decrease, less, if any, truly non-essential trips are in fact made."</u>

Although there have been numerous transportation studies conducted in developing countries over the past decade, data have not been extracted from them and published in a way which would outline the facts specifically relevant to the travel of the elderly.

The data reviewed here are the travel characteristics of the population of the city of Haifa in 1972, as gathered in home interviews (Hocherman, 1985; Reichman, 1976). Haifa at the time was Israel's third largest city with a population of 219,000, including 22,700 persons over 65 years of age. The motorization rate was 120 cars/1,000 persons. (Large urban areas in less developed countries generally have higher rates than the national average, which is influenced by the low rates in rural areas and small poor towns. The national average at the time was 102 cars/1,000 persons).

The data present the key findings by comparing characteristics of three age groups: 25-55; 56-64, and 65+. For some factors, the characteristics are further broken down into the groups: 65-69; 70-74, and 75+.

The relevant background data to the reported travel characteristics are:

1. 8.4% of the older persons had a "car available" compared to 32% for persons 25-55 years of age;
2. 80% of the elderly people had below average incomes compared to 63% for those aged 56-64;
3. 80% of the elderly lived in 1 or 2 person households;
4. 16% of the over 65 were employed : 23% were housewives; 56% were retired, living on pension income; (5% "other").

The major travel characteristics are summarized in Table 2.

The important travel characteristics of the over 65 age group compared to those of persons aged 25-64 are the following :

1. They make less total trips per day, both persons with car available and those with no car available;
2. They make less car trips as driver and/or passenger, except for the purpose of visiting family;
3. They make more use of public transport for all purposes;
4. Their trips are shorter in time duration and in length;

Table 2: Daily Trips Per Person By Age, Haifa, Israel 1972

AGE	25-55	56-64	65-69	70-74	75+
Car Available	3.41	3.25	2.98	1.56	0.73
Car Not Available	1.94	1.71	1.28	0.90	0.58
Mode - Car Not Available:					
Car	10%	7%	5%		
Bus	68%	76%	86%		
Other	22%	17%	9%		
Employed	3.11	2.82	2.57	2.29	1.87
Not Employed	1.20	1.00	1.10	0.76	0.51
Housewives	1.11	1.01	0.88	0.68	0.59
Pensioners	0.64	1.08	1.22	0.80	0.45
Trip Purpose:					
Work	0.71	0.57	0.26	0.09	0.04
Personal, Shopping	0.28	0.22	0.26	0.21	0.16
Leisure	0.19	0.17	0.18	0.12	0.09
Other, incl.Study	1.22	1.11	1.01	0.52	0.32
Total	2.40	1.97	1.71	0.94	0.61
Trips over 30 min.	12%	11%	11%	9%	8%
Trips: 9 a.m.-3 p.m.	30%	33%	42%	50%	51%

5. Elderly living in or near the CBD make less motorized trips than others living in the same area;

6. Elderly living in smaller one or two person households make less trips than persons living in larger households.

The significance of this study of travel characteristics of the elderly in Haifa, Israel, can be appreciated by comparing the findings with other similar studies. On the one hand, studies of trip making in developed countries also show 15% to 25% less trip making by elderly persons compared to other adults, as was found in Haifa. At the same time, it has been found that trip rates in cities of developing countries are 20% to 30% less than trip rates in westernized cities (Mogridge, 1975). The picture that emerges, therefore, is clearly one of highly constrained mobility of the elderly population in developing countries. Furthermore, low per capita income and the associated low rate of motorization mean that private personal transport is extremely limited for the elderly and low paid handicapped, and that money to purchase other alternative transport services is almost non-existent. It is against this background that special transport for the elderly in developing countries would appear to be a social problem of major significance.

The Number of Elderly Persons & Changes in the Structure of the Elderly Population

The proportion of persons over age 65 in the populations of less developed countries is considerably lower than that found in developed countries : in developing countries, the range is from 4% to 9% elderly, while in developed countries it is 10% to 18%.

While U.N. estimates (U.N. 1982) show the average percentage of over 65's reaching 11.5% in underdeveloped countries in about 50 years, they do estimate a steady, year by year increase in both the percent of those over 65 and those over 80 years old. Given the large total size of these countries, it must be realized that every 1% increase means an increase of 20 to 30,000,000 elderly persons. Overall, the U.N. estimates show the population of persons over 60 years old doubling between 1975 and 2025 in developed countries, while quadrupiling in the less developed countries.

In addition to the sheer magnitude of the problem in developing countries indicated by these numbers, it is more than likely that with an increase in the proportion of elderly in their populations, there will come an increased awareness of their problems.

Geographic Distribution of the Elderly Population

The percent of the population living in rural areas is larger for developing countries than for developed countries. Despite a predicted shift of a substantial portion of this rural population to the cities of the less developed countries, representing a trebling of the absolute number of persons living in these third world cities -- the absolute numbers in rural areas of developing countries will still dominate in the year 2000 (U.N. 1982).

The World's Urban Population

Less Developed Countries	Developed Countries	World Average
1975 - 27%	66%	46%
2000 - 42%	75%	55%

Despite the significant percentage of population living in the rural areas of developing countries, the road systems serving these areas are mostly inadequate. Table 3 shows the greater network density of roads in a number of developed countries compared to less developed countries (IRF, 1984). Older people living in the rural areas of these less developed countries can be expected to suffer, therefore, from a general inaccessibility to needed services.

Table 3: Road Density (km/sq.km)

Developed		Less Developed	
Belgium	4.10	Turkey	0.29
Japan	2.97	Israel	0.22
Holland	2.64	Nigeria	0.12
W.Germany	1.96	Venezuela	0.07
England	1.49	Colombia	0.06
U.S.A.	0.66	Liberia	0.05
Australia	0.11	Bolivia	0.04
Canada	0.09	Ethiopia	0.03

The movement from rural to urban areas continues slowly in developed countries, but is fairly rapid in developing countries. Ma Mpolo (1984) reports, for instance, that 79% of the younger population of Lukanga Village in Zaire moved to urban centres between 1958 and 1978, leaving the elderly population behind, essentially isolated and with minimum services. This example of migration is not an isolated case, as noted previously in the data on third world city growth -- an estimated 75% of this growth is migration from the countryside.

Finally, those families arriving in the large cities of developing countries do not, by and large, move into settled, organized neighbourhoods. Rather, they are the backbone of the squatter settlements that surround the major cities of South and Central America and elsewhere. These squatter settlements being on the fringe of the cities are not well serviced by public transport. In addition, the cost of travel for their residents is relatively high, due to their distance from most destinations in the city. Squatters have been found to have higher ownership rates of personal transport than inhabitants of other poor areas in the city, apparently in an effort to help offset these transport disadvantages.

Male to Female Ratio

The number of elderly women outnumber the number of elderly men in developed countries much more than in underdeveloped countries. U.N. estimates indicate that this imbalance will continue through the year 2025, although the differences will diminish somewhat (U.N. 1982). The number of elderly women predicted to migrate by 2025 to the cities of the less developed countries is extremely large, thereby exacerbating an already existing problem by an increase in a population segment which is at present highly immobile.

Sex Ratio - Number of Men to 100 Women

age	Year 1975 Less Developed Countries	Year 1975 Developed Countries	Year 2025 Less Developed Countries	Year 2025 Developed Countries
60-69	96	74	94	78
70-79	88	62	86	75
80+	78	48	73	53

Participation in the Work Force

Developing countries do not, by and large, have equal opportunity laws protecting the aged from discriminatory employment policies. At the Second Regional Congress of the International Association for Gerontology in Singapore, 1983, it was reported that in Malaysia, for example, " ... industrialization has brought about a decline in the economic participation of old people," that the retirement age is 55, and that there is a " ... lack of retirement benefit schemes." On the other hand, there is some evidence that the participation of the elderly in the work force of underdeveloped countries is higher than in the developed countries -- perhaps due to the need by all segments of the population of any small amount of increased income, no matter what the task (Nusberg and Osako, 1980). This continued work force participation could also be influenced by the lack of income security schemes in less developed countries, as shown below:

Statutory Income Security Schemes for the Elderly
(U.N. 1982)

Country	% Scope of Protection	Country	% Scope of Protection	Country	% Scope of Protection
Canada	100%	Kenya	18%	Costa Rica	50%
U.S.A.	94%	Nigeria	6%	El Salvador	14%
Japan	100%	Zambia	64%	Nicaragua	20%
Finland	100%	India	4%	Peru	32%
Denmark	100%	Sri Lanka	28%		
England	100%	Philippines	48%		

A reliable scenario of the future trend of work force participation by the elderly is difficult to draw for developing countries. Unlike relatively consistent predictions of the trend in motorization or the almost fatalistic predictions of population growth, this subject is dominated by uncertainty, partly due to the problematic nature of such issues as : do the elderly feel better when partially employed, despite less than complete leisure? Does the economy need their participation, or is their employ disguised social welfare?

Developed nations also foresee conflicting futures in this area, with possible reverses in the early retirement pattern of the past brought about by : the need for income to compensate for inflation and/or to offset higher tax rates, as well as the availability of suitable employment opportunities requiring little physical exertion and taking place in pleasant surroundings (Bell and Revis, 1984).

Inflation

Developing countries exceed by far developed countries in their annual rates of inflation. The hardship that inflation brings to retired persons is apparently universal. In developed countries with very low rates of inflation, pensions are fixed and largely unlinked, so that even the lowest inflation rate gradually erodes the purchasing power of the pensioner. In countries where inflation rates are high but the system includes compensation (linkage) to the pensioner, there is almost inevitably a time lag and a built-in slippage yielding less than full compensation for rising prices -- including for rises in the costs of transportation.

Recognition of inflation effect on the life style of the elderly was given at the previously mentioned Singapore Gerontology Congress as follows: "Inflation has particularly affected the aged who have fixed low incomes in the form of pensions or are dependent upon what could be spared by their children."

THE CASE OF ISRAEL

Demography and Characteristics of the Population in Need of Special Transport

the handicapped

No detailed survey of the total handicapped population has been carried out. Sample surveys and local special surveys, however, provide useful working numbers in several categories of handicapped persons. The Roof Organization of Israel's Handicapped Persons Organizations uses the generally accepted international figure of 10% of the total population. This would mean that there were approximately 400,000 handicapped persons in Israel in 1983 -- compared to 343,000 persons over 65 years of age (without accounting for the overlap in the two groups).

The Roof Organization encompasses organization of the physically handicapped, mentally retarded, minor brain damage, deaf, blind, mentally ill, traffic injured and others. The organization also uses a figure of 150,000 - 200,000 transportation handicapped as an acceptable estimate.

the elderly

The population of persons over 65 years of age in Israel numbered 343,000 in 1983, being 8.4% of the total population. While the absolute number of elderly is expected to grow in the next two decades, the number and proportion of those over 75 will increase at a greater than average rate.

Of the total population of elderly persons, 75% live in a family framework and 25% live alone or in institutions -- this latter group is largely women. Of those living in a family framework, about one half are the heads of two person families and the other half live with family -- children or others.

A significant proportion of those over 65 live in the same apartment or building as one of their children. The overall proportion is 28%, but in certain ethnic groups (who total 30% of the elderly population), 49% live in the same building or apartment.

In light of Israel's highly urbanized population, it is obvious that almost all elderly are found in urban centres -- 93%.

Eighty percent of Israel's elderly receive a government old age pension. This pension comprises the sole income of two thirds of those who live alone and one third of those who are married. Together with other social benefit payments, this income provides elderly persons with about one third of the national average family income.

The participation of the elderly in the labour force has decreased from 36% in 1960 to 25% in 1980. Of those persons aged 65-69, 50% are employed; 29% of those 70-75; 19% of those 75-79; 14% 80-84; and 9% of those over 85. (Israel CBS, 1982).

National Policy and Programs

The special transportation needs of the elderly and handicapped in Israel have not been the focus of particular public attention. Neither has there been specific parliamentary adoption or ministerial declaration of policy on the subject. Nevertheless, there is government support for special programs which, although they in no way meet the total needs of the population, do provide cover in a number of important areas. The operative programs are the following:

a) Mobility payments to severely handicapped persons so long as they continue working (recipients account for 2½% of the total number of handicapped);

b) Mobility payments and financial aid to war veterans;

c) Concessionary fares for the elderly and handicapped on public transport (average of 33% reduction on city buses and intercity trains);

d) A national building law (1980) requiring construction of accessible public buildings (partial implementation to date).

Social Service Transport: Mobility Programs at the Institutional and Local Level

Israel's elderly and handicapped, including the mentally and physically handicapped, are served by a wide variety of institutionalized arrangements:

1) Community recreation centres and clubs; 2) Day care centres; 3) Sheltered housing; 4) Sheltered employment; 5) Homes for the aged, retarded, and handicapped; 6) Hospitals for the aged and retarded; 7) Medical centre outpatient treatment; 8) Home services and care : nursing service; physiotherapy; meals on wheels; home keeping.

The special transport needs of the recipients of the eight services are almost entirely supplied by the institution providing the service in question -- with the exception of the community recreation centres where most users must provide their own transport -- walk, bus, etc.

In addition to the above, over 95% of Israel's elderly and handicapped population are insured with one of the national health insurance schemes (most often a scheme of the Labour Federation). This insurance includes transport rebate coverage for recurrent outpatient clinic service (such as dialysis).

In practice therefore, what exists is a small network of institutionally owned or operated minibuses and 7 seat taxis for the transport of the users from home to institution, and passenger cars or small utility vehicles to bring nurses, other professional persons, and paramedic aides to the user.

THE DEVELOPING COUNTRIES' RESPONSE

Responding to Need: Conventional and Intermediate Public Transport

In developing countries, with their low rates of private motor car ownership, there has been constant pressure to expand the supply of conventional and innovative forms of public transport. The use of 2-wheel motorized and non-motorized vehicles for personal transport has grown as an alternative to the motor car, while private operators have focused on the supply of non-conventional public services. At present, a significant portion, estimated at 30% (Fouracre, 1984) of the public transport industry in many developing countries, is based on 'intermediate,' 'para,' non-conventional vehicles, classified as :

1. fixed route types (similar to conventional buses)
   non-fixed route types (similar to conventional taxis);

2. mechanical powered (auto rickshaw, vans, mini-bus)
   - human powered (hand rickshaw, cycle rickshaw)
   - horse-drawn (tonga, cart).

The mechanical powered vehicles, those operating on fixed routes, as well as those on non-fixed routes, have been expanding their operation rapidly in recent years.

Jenkins' (1979) study of Baroda, India, a city of 574,000 persons (1977), is illustrative of the above trends.

Vehicle Growth in Baroda, India:

	1967	1977	% Changes
motorcycles	4,000	22,000	+450%
auto rickshaw	3,000	8,000	+166%
motor car	2,000	3,500	+75%

Modal Split in Baroda :

Bus	42%
Pedalcycle	30%
Walk	9%
Autorickshaw	9%
Motorcycle	5%
Car	4%
Other	1%
	100%

Passengers by Age in Baroda:

Age	Autorickshaw	Bus
to 10 years	-	2
10 to 20	10	15
20 to 40	50	60
40 to 60	30	18
over 60 years	10	5
	100%	100%

The autorickshaw, although a more expensive means of public transport compared to a bus, obviously has an important place in the transportation of Baroda. It was of major importance in social trips, and most important, was acceptable to the older traveller.

Similarly, studies in other developing countries of these intermediate (Silcock, 1981), paratransit, forms of public transport indicate their significance in the transportation systems of cities of various sizes.

These non-conventional public transport forms have many of the operational characteristics required of the specialized types of transport needed for the elderly and the handicapped. It is probable that they are used to a certain degree for this purpose.

Recognizing Mobility Needs

From the documentation supplied by United Nations member countries during the Year of the Aged, 1982, it appears that very few developing or third world countries have government sponsored or other formal programs and policies in the area of special transport for the elderly and handicapped. On the other hand, the gerontological and social work professionals of these countries have expressed recognition of the problem on numerous occasions. The nature of their resolutions on this matter is in the direction of calls for subsidized transport for the aging, as in the following quotation from the 1984 African Conference on Gerontology:

> "The aging should benefit from special transportation rates to help them maintain their purchasing power and permit them to be better able to contribute to general economic development."

or, from the Proceedings of the International Association of Gerontology Regional Congress in 1983:

> "In addition, there are no concessionary travel schemes, other than that provided by the Malaysian Railways for the still mobile elderly, nor are there special provisions to ensure the safety and comfort of the elderly when they travel."

or, from Aging: An International Perspective (1982):

> "Public and private transportation systems should be expanded to increase access by aging to social services and other travel. The aging should be able to travel at free or reduced fares. Equipment and facilities should be designed that can be used easily by the aging."

The Socio-Cultural Response

Within the context of reported deliberations on the management of the old age problem in third world countries, two themes dominate:

the first

> "There is danger in copying assistance to the aging on the European pattern." (Aging and Development in Africa - Conclusion of a Working Group, May, 1983).

or the more moderate expression of the same idea:

> " ... fusion of the best of all worlds by creating a mixture of tradition ..." (Aging: An International Perspective, 1982).

the second

In respect to the easement of most of the problems of aging -- housing, health care and transport, and in relation to the above theme -- the considered approach was that of family preservation:

> "We must find our own way that can take into account our traditional values ... The real issue is to maintain the unity of the family ... The elderly rarely live on their own in Africa ... Assistance and support for the elderly was a family responsibility ..." (Aging and Development in Africa).

and from The Situation of the Asian Elderly, 1980:

> (Japan) " ... if they can share their dwelling with their children ... their needs for community support services will be much smaller ... For most Japanese people, co-residence is quite natural ... even today, three of four old people share their dwelling with married children ..."

> (India) "In India, it is expected that when a person grows old he will be provided a home by his married sons ..."

from Aging: An International Perspective (1982):

> " ... reassert the importance of the family ... other ideas from outside may be imported, but not at the expense of family neglect ..."

The implications of this approach for curtailing demand by the elderly on transport facilities is obvious, and is similar to the anticipated reduced demand for use of other community support services mentioned in the quotations.

CONCLUSIONS AND DISCUSSION

Conclusions

Although the elderly are a smaller percentage of the population in less developed countries than in developed countries, their absolute number is vast and growing; they are "overrepresented" in the lower economic strata, and they are migrating from the countryside to the physically trying, non-traditional environment of the large city -- or even more difficult, they are being left behind in the village while younger members of the family find employment. Like their counterparts in the developed countries, they travel substantially less than adults of the ages 45-64 wherever they live. It is reasonable to conclude that the transportation situation of the average elderly person in an underdeveloped country is one of severely constrained mobility. Further, it would appear that only a bare minimum of those in need of special transportation are receiving help of any kind.

Politicians and administrators concerned with old age, disability, and public transport appear to consider existing mobility programs to the extent that such programs exist at all, as meeting minimum critical needs. Within the framework of the economic constraints in which they operate, they express little hope of introducing more progressive programs. In fact, it seems that these officials, unlike the professional gerontologists and social workers in their countries, are unaware of the full needs of the transportation disadvantaged.

Fare reduction on public transport is the cornerstone of official policy in respect to helping the aged -- in those limited number of countries which have some type of policy and program (Vasconcelos and Sola, 1984). The second major policy approach is financial aid to very limited groups of disabled persons in need of special equipment (Elshabani, 1984). Finally, institutions rendering medical services, or who provide community recreational facilities, are in some cases equipped with their own vehicles.

The great majority of elderly and handicapped in need remain without institutional aid and depend on family for arranging and financing needed service. Organized voluntary social service transport is rare (Collins, 1984). It is probable that in addition to family help, a neighbourhood network of informal social support operates to ameliorate the transport situation of those in need (Fleishman and Shmueli, 1985).

Improved public transport service is a recognized economic and social policy goal in most developing countries. Conventional stage buses, taxis, shared taxis, intermediate para-transit vehicles from minibuses to autorickshaws, are active in attempting to supply transport demand. There is, however, no "good service" for the elderly and handicapped: bus and train terminals are mostly inaccessible; information services are poor, if they are available at all; baggage handling help for trains and buses is inconvenient; entry and exit to shared taxis and other non-conventional vehicles is physically difficult.

Public transport operators, in other words, offer the general public a wide variety of service in respect to price and vehicle characteristics. Nevertheless, the barriers to use in general, including "operational barriers," and to comfortable use in particular, are formidable, and without doubt contribute to depressed ridership by the elderly and handicapped.

Discussion

"The whole range of transport related problems (in developing countries) is not just different in emphasis, it also differs in character ... environmental problems generated by traffic are apparently unperceived by the population of developing countries. I would suggest that the ideas of "environment" and "congestion" are alien concepts ..." (Willumsen, 1977). In a similar vein, it must be admitted that it is unjustified to foist Western concepts of transportation equity or levels of mobility "need" onto underdeveloped countries. Once need is established, the basis exists for demands on public financial resources since, as is

most often the case, the "need" in question can usually be related to a disadvantaged group. By definition, developing countries already have demands on public resources far in excess of their available resources.

In practice, there is little likelihood of these countries adopting Western standards of need in respect to transportation for their elderly. They will establish, implicitly or explicitly, their own standards of "normative" and/or "comparative need" (Skelton, 1979). Moreover, it has been pointed out in the body of this paper that gerontologists and social workers in the developing countries are, seemingly, universally convinced that traditional family life and custom should be the framework for the life style of their elderly. Mobility "needs" within a family framework are likely to be much less demanding than those of the Western model of activity for the elderly. Given the conflicts between tradition and modernization, it is, of course, difficult to assess the way in which the style of elderly life in the third world will develop.

Developing countries, trying to solve their problems, are now cognizant of the risks of "imported" solutions. At the same time, however, they are not generally ready for more surveys or more locally oriented research -- given the extended time frames of such programs. Their response is often one of on-going development and experimentation whose main thrust is meeting an actual problem in real time. Such, in retrospect, is the history of the development of public transport in these countries. The innovative use of non-conventional vehicles, the exploitation of private capital resources, and the range of market-oriented services offered, are the hallmarks of the success now recognized as a transport model which can possibly be transferred to the West!

These para-transit services already have some of the key attributes of the special transport needed for the elderly and handicapped, namely: demand response and flexible routing. Their further development, oriented to the needs of this market, could become a first example of an indigenous improvement in the mobility situation of this substantial segment of the population.

There are other options open to the developing countries for improvement -- some of which are already "routine." This refers to the utilization of authorized development budgets in such a way that at no incremental cost, additional objectives are reached. For this to be an effective procedure, however, requires a more widespread understanding and recognition of the problems of the transportation disadvantaged than presently exists in the less developed countries.

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2.0 POLICY AND REGULATION

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THE RELATION OF MODE AND URBAN FORM FOR
TRANSPORTATION FOR DISABLED PERSONS

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The Relation of Mode and Urban Form for Transportation for Disabled Persons

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I. INTRODUCTION

The question, "Which mode provides transportation for individuals with disabilities most efficiently?," has been analyzed extensively. However, several important factors have been left out of the debate. These factors are the influences of spatial differences and temporal change. In this paper, I will address the question of making fixed route transit accessible vs providing a special paratransit system, and I will show that the cost-efficient solution depends on the location of the service area. Accessible fixed route bus systems are cost-efficient in large, transit-oriented cities; in small or auto-oriented cities, paratransit systems are more cost-efficient. I will also show that changes in the habits and attitudes of individuals with disabilities, technology, and the environment will play a part in the cost-efficiency.

In Section II, I will discuss the context of living in a society that depends primarily on the automobile, the nature of cost analysis for fixed route and paratransit, and the importance of demand in determining the relative costs of accessible fixed route and special paratransit. In the third section, I will look at demand and how location and time affects demand. In the fourth section, I will develop costs for both modes and show how the location of the service area affects costs. The final section will summarize the conclusions.

II. BACKGROUND ISSUES

The Transportation Context

The majority of travel in the United States is by automobile. By the mid seventies, 84 percent of all trips were made by private vehicle (MVMA, 1982). This percentage has been climbing steadily since the automobile started being mass produced, with small temporary declines after the second world war and during the 1973 oil embargo. A large proportion of residences, stores, and jobs are difficult to reach without a car, and because of the low density life style encouraged by the automobile, public transportation has become less efficient, carrying a smaller proportion of the population and fewer passenger trips per vehicle.

The public transit systems that provide good levels of service and geographic coverage tend to be located in the central cities of older urbanized areas. While transit proponents claim that transit serves the needs of the economically and physically disadvantaged and reduces energy use and air pollution, transit's greatest strength is in getting large

numbers of workers to jobs in congested CBDs. In 1980, only 6.4 percent of all work trips in the United States were made by public transportation; however, double that proprotion or 13.0 percent of the work trips that were destined to jobs in central cities were on public transit. In New York City, 83 percent of all work trips to the central business district (CBD) were made be transit. (U.S. Bureau of Census, 1982) Thus, the importance of public transportation within the overall travel system depends on the characteristics of the city and the type and destination of the trip.

Most efforts to meet the transportation needs of the handicapped in the United States have been concentrated on special paratransit services provided by social service agencies, local governmental bodies, or transit agencies. Because the nature of these programs restricts them to either particular types of trips or particular geographic boundaries, the travel of the handicapped who do not have access to a car, even with good and fully implemented programs will continue to be restricted. In large urban areas, many desired activities located in low density areas or at the periphery will be unserved by transit and may not fall into the service area of a special transportation service. Further, because service areas are frequently restricted to local governmental jurisdictions, trips across a metropolitan region are very difficult. In most areas outside large central cities, true mobility is only possible with an automobile, yet little of the concern for transportation for the handicapped has been directed toward the automobile.

Programs in Sweden and the United Kingdom illustrate broader policies. The Swedish government will provide financial assistance for the disabled who meet a means test and who need a car for work or education. They also provide grants for the full cost of special equipment or adaptations that enable the disabled person to drive. Recipients of assistance are also exempt from a special tax on automobiles and are eligible for a fuel allowance (Norrbon and Granstrom, 1984).

The government of the United Kingdom will provide a mobility allowance (£18.30 per week in November, 1982, which was roughly equivalent to $40 in U.S. currency) for people who cannot walk or can only walk with difficulty. The mobility allowance can be used on any form of transportation including the purchase and/or operation of an automobile. There are special programs whereby the mobility allowance can be signed over to a car dealer for a length of time, thus obviating the need to first accumulate a down payment. (U.K. Department of Transport, 1981).

In the United States, transportation for the handicapped has been introduced to the federal arena as a civil rights issue; that is the handicapped have an equal right to use publicly supported services. Thus, instead of attempting to improve the mobility of the handicapped, policy has been directed toward giving the handicapped access to existing public transportation or providing an equivalent service.

Special Services vs Accessible Fixed Route

Much of the argument of special services vs accessible fixed route transit concerns issues of human rights and human dignity. These have been

addressed in other papers by people more qualified to discuss them. I will restrict my discussion to arguments of efficiency and effectiveness.

An unconstrained special transportation service can be considered more effective than making fixed route transit accessible in several ways. A special service can take passengers to any location within a service area while a fixed route system may not serve all locations. A special demand responsive service will take users to their destination at a time specified by them, while a fixed route system may have a long headway requiring the users to plan their trip to match the bus schedule. A special service can be extended into areas with no fixed route service.

Most importantly, a larger proportion of the transportation handicapped can use a special service than can use accessible fixed route transit. A 1977 survey conducted in Chicago (DPW, 1978) found that 48.8 percent of the mobility limited (defined as people who have some difficulty or cannot use public transportation) non-transit users said that they would use a fixed route bus if it were lift-equipped while 58.6 percent would use a door-to-door service. According to non-users, the most difficult activity involved in taking a bus was standing on the moving vehicle. Although many transit systems have policies that give priority to elderly and handicapped passengers for certain seats, these policies are not always well enforced. They are particularly hard to enforce in large, transit-dependent cities such as New York and Chicago.

However, few special transportation services are unconstrained. Most attempt to limit demand with such devices as long reservation times, high fares, limits on types or number of trips, or restrictive eligibility criteria. Even so, many services still have to turn down reservations. The uncertainty of getting a trip is a major detraction to a service. If individuals are to take an active role in society, they must be able to plan their travel knowing that they can make the trip. Accessible fixed route transit, while providing a lower quality or less effective service in many ways, does have the major advantage of not placing an arbitrary restriction on the disabled user's ability to use the service. However, because a significant number of the disabled would not be able to use even the most accessible of fixed route services because of the problems of getting to the bus stop, the ideal system from the point of view of the disabled would include making the main line transit system accessible and providing a special service for the disabled that still cannot use fixed route transit. Below, I will show that a multimodal solution is, in some locations, the most cost-efficient solution.

Cost Efficiency Comparisons

Before trying to compare the costs of the two types of systems, it is important to understand the difference in how the costs occur. The cost attributable to making a fixed route bus system accessible is a marginal cost; it includes only additional costs over the cost of the existing system. However, the relevant cost for a special service is usually the total cost of the system.

Second, the total cost of making a fixed route system accessible is independent (or almost independent) of the number of people who use the accessiblity features. Therefore, the total annual cost is basically a constant. The unit cost or cost per trip is the total cost divided by the number of users; thus it is a function of the number of users. Nearly the opposite is true of special services. While there are some economies of scale, the cost per trip, given a fixed operating environment, varies within a small range. Thus, total cost increases with the number of trips provided. This is why most special services need to restrict demand as described above.

Costs for accessible fixed route systems are difficult to estimate because experience with them is still limited. Only a few, relatively small bus systems are totally accessible; the technology of the lifts and resulting maintenance methods are still in a state of flux, and costs and usage for most systems have not stabilized. For these reasons among others, reported costs vary drastically. A 1981 report (Rosenbloom, 1981) documented six accessible fixed route systems with annual marginal costs per lift-equipped bus varying from $480 to $4200 (the reported costs do not include all the same items). For special services, costs per vehicle hour vary from $3.50 to $40.00 (McKnight, 1985).

The remainder of this paper will discuss and compare demand and costs for both special paratransit and accessible fixed route system, showing how they vary with location.

III. DEMAND

Analysts have used two different sources for estimating demand by individuals with disabilities for either an accessible bus system or special paratransit system: 1) surveys that ask the person how much they would use the service if it were available, and 2) empirical ridership figures for existing services. Demand estimates based on data from these two sources vary widely, the first source giving much higher figures than the second. The survey method suffers from noncommitment bias, i.e., the tendency for people to overstate their responses when they are making a hypothetical, rather than actual, decision. Hartgen, Pasko, and Howe (1976) estimated that actual demand will be from one third to one half that which the survey respondents suggest.

On the other hand, empirical data, particularly that for paratransit systems, may understate demand. Demand for special paratransit is affected by many system characteristics such as fare, minimum reservation length, reliability, eligibility requirements, marketing, and, most important, supply. Many demand responsive paratransit systems are supply constrained in that they have to turn down riders, at least at certain times of day. Constrained supply limits not only the actual number of passenger trips provided, but also the number of trips requested; after being turned down several times, many potential users stop trying to use the service. For important trips they will find another means that they can rely on although it may be less desireable in other ways. However, most methods of estimating demand from empirical data take none or only a few of these

factors into account. In particular, few studies of empirical demand take into account whether the paratransit system is supply constrained; if it is, the method estimates supply rather than demand.

On the other hand, accessible bus systems almost never suffer from a supply constraint, in the same sense. During peak hours, a fixed route bus may be full, thus apparently also suffering from a supply constraint; however, the unserved passenger usually has the option of waiting for the next bus. (In this case he or she is treated the same as the abled-bodied transit rider.) The more important supply limitations on bus service take the form of infrequent bus service, no service at certain times (e.g., late evening or night), or no service in certain areas.

Many other system and environment attributes affect demand by lift-users. Rosenbloom (1981) suggests the following:

* Reliability of accessible service
* Frequency and availability of lift-equipped buses
* Driver attitudes
* Percentage of routes with accessible service
* Type and quality of user information and training
* Percentage of bus stops with a loading problem
* Negotiability of streets and sidewalks
* Accessibility of trip attracters

Rosenbloom makes the point that the most important factor is the commitment of management to providing accessible service; a firm commitment by upper management will affect attitudes throughout the agency and the adequacy of the resources (including attention) dedicated to accessibility. Another factor that affects demand for lifts is whether the bus system allows standees to use the lifts. Several systems only allow wheelchair users, others allow anyone who asks to use the lift. Weather and the configuration of the bus routes (whether the network is a spoke system or a grid system, which requires more transfers) have also been suggested as important factors. Exhibit 1 shows the large variation in demand for several partially to fully accessible fixed route bus systems. There is a tendency to use the high or the low demand figures depending on whether the person is arguing for or against accessible fixed route. So far, no one has been able to analytically explain the variation in demand for lift service, although no doubt all the above issues play a role. Additionally, two important factors have been left out of the demand analysis: time and location.

Temporal Effects

Demand for transportation by the disabled grows with time. For years many of the disabled (those who could not afford a car or could not drive) have had very limited mobility, having to depend on friends or relatives or on expensive ambulance-like services for transportation. As a result, they have had very limited expectations about their travel capabilities. When inexpensive transportation has become available, they have learned to use it only gradually. Demand for newly available transportation has increased slowly as the disabled have learned: first, that the system was available to them; then, how to use the system and that they indeed can use it; and

Exhibit 1
Lift Use for Accessible Bus Systems

Large systems	Total lifts	Total fleet	Percent lift equipped	Daily* lift use	Daily lift use per lift	Source
Los Angeles	1862	2949	63%	40.5	0.02	1
NYCTA	1687	3940	43%	39	0.03	2
Seattle	577	1165	50%	250	0.43	3
Oakland	527	825	64%	100	0.19	1
Denver	432	768	56%	45	0.10	1
Washington	151	1875	8%	7.5	0.05	1
Small systems						
Eugene.Ore.	87	87	100%	30	0.34	4
Champaign	51	51	100%	15-25	0.39	5

* Daily use refers to use on an average weekday; when the source provided annual use rates, daily rates were derived by dividing by 300 to account for the difference between weekday and weekend use.

Sources:

1. CTA, 1984.
2. Hearn, 1985.
3. Carrol, 1985.
4. Loobey, 1985.
5. Volk, 1985.

finally, to make trips that in the past were not possible. If the system is supply constrained, the last lesson will probably not occur. Additionally, there will be a generational effect. Disabled people who have inexpensive and convenient transportation available to them from a very young age are liable to develop a more mobile life style. Further, the policies of the Rehabilitation Act of 1973 and many of the advocacy groups for the disabled (such as Access Living) is to encourage independence; as more of the disabled are employed and take a more active role in society, their demand for transportation will increase.

The paratransit system in Gothenburg, Sweden, provides evidence of the growth in demand over time. (Schnell, Elmberg, and Maynard (1986) included 18 years of ridership data for the system.) The system was started in 1967 and has two components: a special van service for people who cannot use an ordinary car and taxicab service for those who can. Demand for van service is constrained by the number of vans in the fleet; Exhibit 2 shows the relation of demand to fleet size. The rapid growth in taxi trips (Exhibit 3) indicates that taxi supply is not constrained. Demand in the third through fifth years (the year of implementation is likely to be atypical so it was excluded) grew in the range of 45 to 70 percent per year. In the last several years of the data (15th through 18th year of service - not quite a generation), growth in ridership has flattened out to one or two percent, but there is still a small increase in ridership.

Fixed route systems have only had accessible vehicles for a few years. Because no system has been fully accessible for a long period, it is difficult to fully assess the growth in demand over time. Looking only at individual routes that have been accessible for several years can give some indication of the increase in demand with time. Exhibit 4 shows ridership on routes in the Seattle Metro system that have been accessible for a three and a half year period. Exhibit 5 shows monthly ridership for routes in the Champaign-Urbana transit system over a 24 month period. Both graphs indicate growth in ridership with time although it is not at a constant rate. Additionally, Volk of the Champaign-Urbana system (1986) reported that when the system became 100 percent accessible in the fall of 1984 there was significant increase in systemwide ridership.

Ridership data from these three systems support the argument that demand by the disabled for transportation will increase with time as they become use to using it and change their habits in response. Volk's comment suggests the not surprising implication that demand is related to the extent of the transportation available. Thus a 50 percent accessible fixed route system may well attract less than 50 percent of the trips of a fully accessible system. It is reasonable to expect a growth trend in ridership by the disabled for one to two generations, gradually flattening out and becoming somewhat constant except for the changes occasioned by the economy, dispersion of the population, gas prices, etc.

Urban Form

Estimates of demand by the disabled have generally ignored the differences between cities in use of public transportation so far. In a sample of 90 SMSAs (from the 1980 Census) ranging in population size from

Exhibit 2

Trips vs Vehicles

Gothenburg

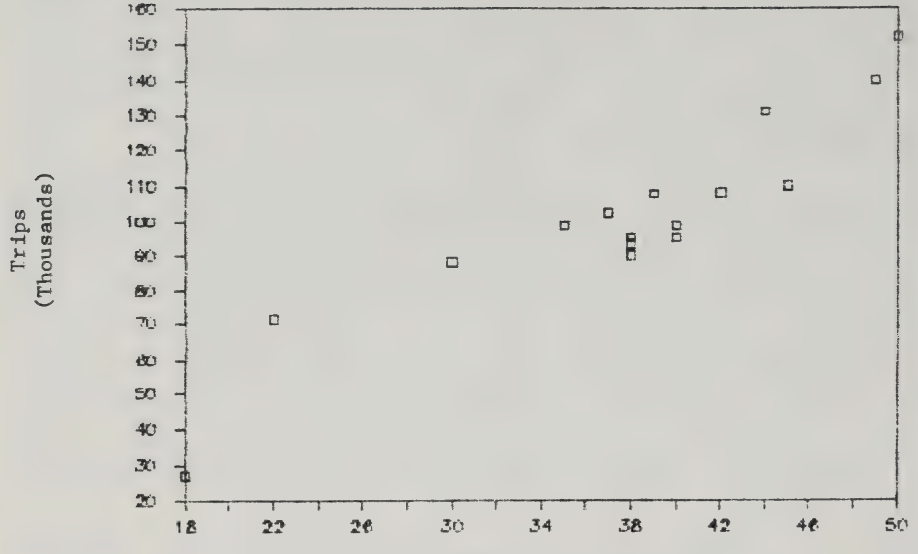


Exhibit 3

Ridership Growth in Gothenburg

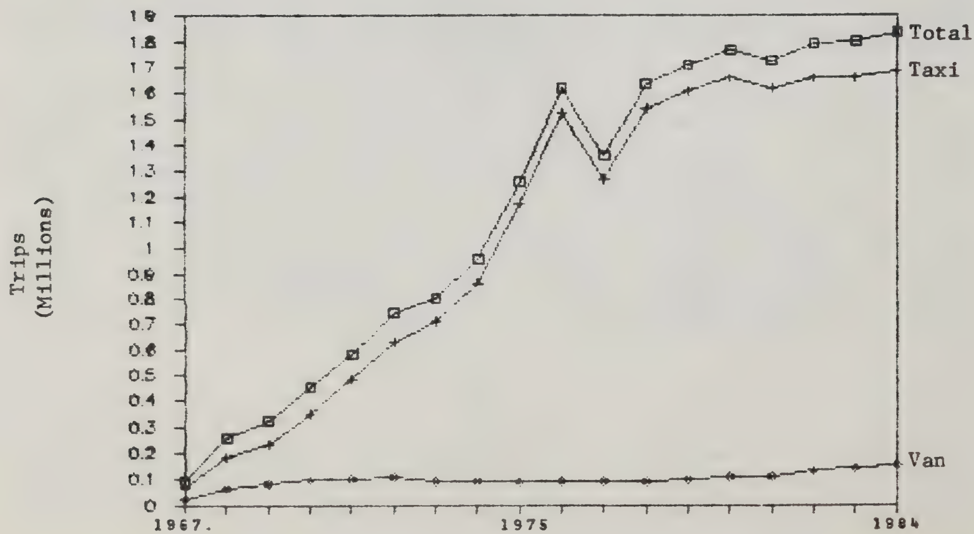


Exhibit 4

Ridership on Selected Routes

Seattle Metro

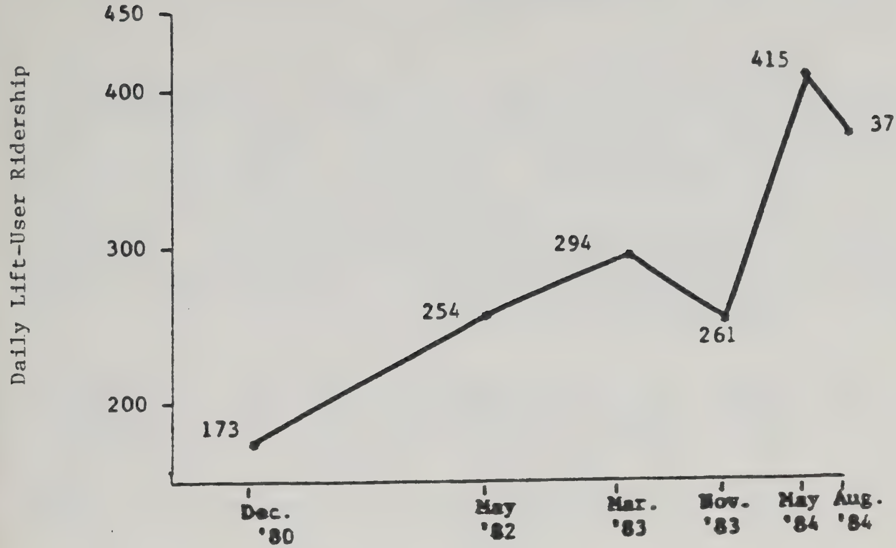
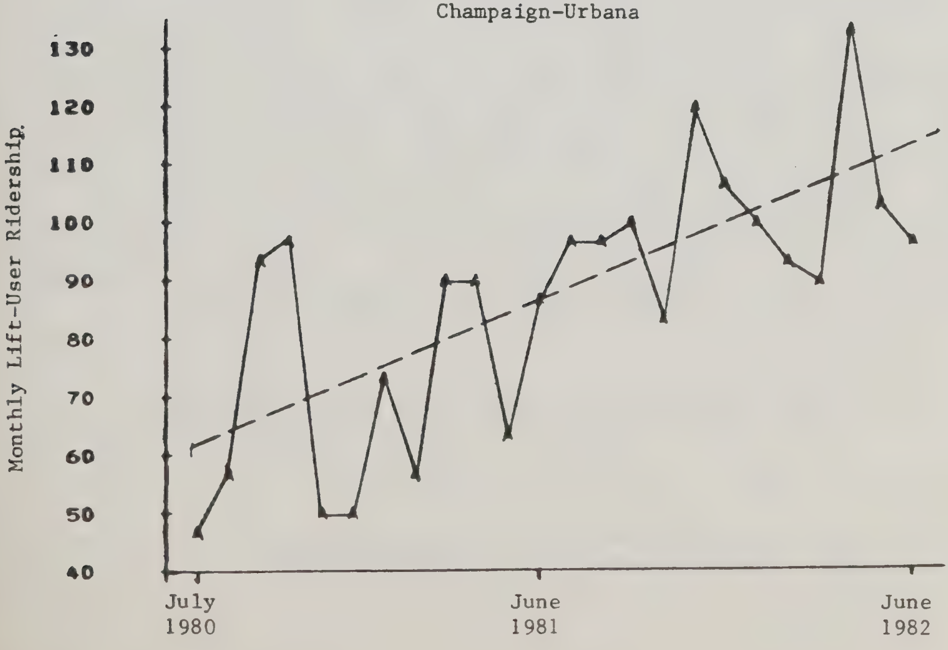


Exhibit 5

Ridership on Selected Routes

Champaign-Urbana



85,000 (San Angelo, TX) to 16 million (New York City), transit use varied from 0.6 to 30 percent in the urbanized area and 0.3 to 56 percent of work trips in the central city.

In cities and central business districts that are densely developed, competition for the use of land is high. As a result, traffic congestion and parking costs are high. In these cases, the incentives for using transit are much greater (Pushkarev and Zupan, 1977). This is particularly true for the central areas of large, older cities; transit use for work trips to the central business district is generally high (see Exhibit 6) for older, large cities and low for younger and smaller cities. The older cities developed when workers depended on transit and developed at densities allowed by transit and encouraging to transit use. Younger cities developed after the car and at the lower densities needed by and allowed by the automobile.

In the high density cities with their inherent incentives to use transit, high ridership provides the political and financial support that makes an extensive transit system possible, which in turn attracts even more riders. In cities like Chicago and New York, most areas of the city can be reached by transit and at all or most times of day. In auto-oriented cities, the transit system generally serves only the high travel corridors and ceases operating in the late evening and at night.

Again in New York and Chicago, owning a car is expensive due to high insurance cost and the difficulties of parking. Because of the extensive transit systems, it is possible to be very mobile without a car, while in auto-oriented cities, being without a car restricts access at many times of day and to many locations within the city.

Using data from the 1980 census (Bureau of Census, 1984) and 1983 Section 15 (Transportation Systems Center, 1984) on 90 SMSAs, I tested the relation of transit use to the size, density, and age of city, and the extent of the transit system. To measure the age, I used the ratio of the 1900 population to 1980 population of the central city. If this number is large (say over 0.50), it indicates that the city had reached a high proportion of its current size by 1900, before the advent of the automobile as a major factor in urban form. The variable ranged from 0 (for cities that did not exist in 1900) to slightly over 1 (for the city of Pittsburgh, which has a smaller population now than in 1900). I tried several measures of extent of service, including route miles, vehicle miles, vehicle hours, the ratio of vehicle miles to the square mile area of the city, and the ratio of vehicle miles to route miles. The last (vehicle miles to route miles) was the most successful; it might be seen as a measure of frequency of service.

The best test model was:

$$\underset{(3.8)}{TU = -2.69} + \underset{(5.0)}{0.06\ CBD} + \underset{(4.8)}{0.94\ DENSITY} + \underset{(5.8)}{8.6\ AGE} + \underset{(2.3)}{0.18\ VM/RM}$$

$R^2 = 0.89$ $\qquad$ $n = 89$

where TU = Percent of work trips by transit
CBD = Number of people who work in CBD (1000s)

Exhibit 6

Transit Use by City Type

City	People who work in the CBD	Percent of City work trips by transit	Percent of CBD work trips by transit
Large, older cities			
New York	445,575	56	83
Chicago	276,235	36	75
Philadelphia	171,341	31	60
Younger cities			
Houston	102,240	3.9	15
Indianapolis	65,327	4.0	12
Phoenix	55,695	2.7	8
Small cities			
Champaign-Urbana, IL	6629	5.6	6.2
San Angelo, TX	6278	0.3	0.2
Rockford, IL	4749	1.3	3.1

Source: Bureau of the Census, 1984.

DENSITY = City population per square mile (1000s)
AGE = Ratio of 1900 population to 1980 population
VM/RM = Extent of service: 1000 vehicle miles per route mile

The model explains 87 percent of the variation in transit use. It implies that the older, densely settled cities with large CBDs and extensive transit service experience the highest levels of transit use.

While the disabled do not use public transportation as much as the general public, the factors of city density and extent of transit service that cause the general public to use transit also affect the disabled. Thus, the disabled are more likely to use public transportation in large, dense, old cities with extensive transit systems than in small or low density cities built up since the automobile has become the dominant mode.

The cost comparisons depend on the number of lift trips per lift equipped bus (for the cost per trip for accessible fixed route buses) as well as the total demand (for the total cost of a paratransit system). The intensity of use of a bus system varies significantly from 22,000 to 341,000 annual trips per peak bus. Exhibit 7 suggests that passenger trips per bus is closely related to the percent of work trips by bus. Therefore I developed the following model to predict passenger trips per bus as a more useful measure of transit use for the purposes of this paper.

The best model was:

$$\underset{}{PT/PB} = \underset{(8.3)}{60{,}000} + \underset{(2.9)}{325\ CBD} + \underset{(3.5)}{7016\ DENSITY}$$

$$R^2 = 0.54 \qquad n = 89$$

where PT/PB = annual passenger trips per peak bus.

The model explains 52 percent of the variation in annual passenger trips per peak bus. The model suggests that the intensity of use of an individual bus is higher in dense cities with large CBDs.

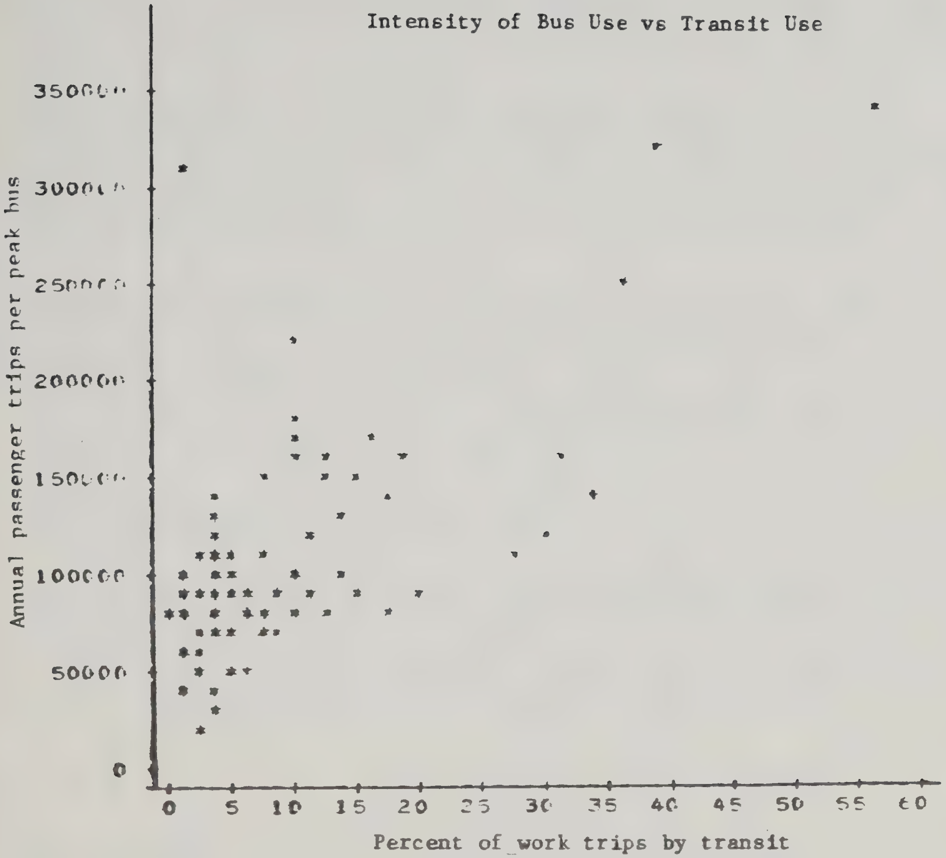
In order to illustrate the effect of city size on demand and costs, I will develop demand cost estimates for accessible fixed route bus and special paratransit in a large city (Chicago, IL) and a small city (Champaign-Urbana, IL).

According to the 1980 Census, the city of Chicago had a 1980 population of three million. (The SMSA was seven million.) The population of people over 16 years living in the city who had a public transportation disability was 110,294. A study done by the Chicago Department of Public Works (DPW, 1978) indicated that 3.55 percent of Chicago's population (or about 106,000 in 1980) is mobility limited. The Chicago Transit Authority (CTA) has a fixed route fleet of 2275 buses and an extensive rail system. The CTA is in the process of making the rail system accessible.

Champaign-Urbana had a 1980 population of 94,000. (The SMSA was 168,000.) The 1982 population of the Champaign-Urbana Mass Transit District

Exhibit 7

Intensity of Bus Use vs Transit Use



(MTD) service area was 110,000 (Rhyner and Webb, 1984). The 1980 census reports 1522 individuals over 16 with a public transportation disability for the two cities. Booz-Allen (1980) estimated that the number of wheelchair users was in the range of 253 to 414. The Champaign-Urbana MTD fleet is 51 vehicles. The Champaign-Urbana Mass Transit District (MTD) bus system is currently accessible. For some items associated with accessibility, the MTD has recorded the costs; in these cases, I will use these actual costs rather than estimates.

It should be noted that Champaign-Urbana, which is the site of the University of Illinois, is exceptional in the number of individuals with disabilities in the community. The University is the home of the nationally known Rehabilitation Education Center, and the University has been accessible to the handicapped since the 1950s. Because of this, the costs and lift usage from Champaign-Urbana will be treated as optimum.

Two general methods of estimating demand are used here; one is base on survey results, the second, on empirical ridership figures. The National Cooperative Highway Research Report 262 (Wegmann et al., 1983) developed a worksheet for estimating demand for accessible fixed route bus based on survey results. Exhibits 8 and 9 show the calculations for Chicago and Champaign-Urbana. The Champaign-Urbana estimate (65 lift trips per day or a daily rate of 1.27 per lift-equipped bus) is much higher than the actual rate that the fully accessible system is currently experiencing (15-25 per day or a rate of 0.39 per lift-equipped bus; see Exhibit 1). Additionally, the NCHRP method indicates that the daily lift-use rate for Champaign-Urbana (1.27) would be higher than that for the Chicago Transit Authority (1.06). Given the much more intense use of CTA buses than Champaign-Urbana buses (see Exhibit 10, Passenger per peak bus column), it seems unlikely that this would occur if the two system were similar in other ways (e.g., marketing, lift reliability, etc were of the same quality). The higher estimated rate for Champaign-Urbana occurs because the NCHRP method does not take into account the characteristics of either the city or the bus system. Because of these inconsistencies, I will rely on the demand estimates based on the empirical data.

In using empirical ridership figures, there is the question of which system's figures are most representative. Even for a system that is accessible, the ridership figures are for a time when the system has been accessible for a few years; in 10 or 20 years, lift-use ridership will be much greater.

If Chicago lift-use rates are to be based on empirical figures, some consideration of intensity of transit use should be made. Exhibit 11 estimates daily lift-use in Chicago if all the characteristics of the lift service were the same as those of each of the cities listed in the table, except for the general propensity of people to use buses. The table assumes that the city-specific incentives to use a bus apply to the person who needs a lift just as they do to the general public.

The lift-use rates estimated for Chicago vary from 0.02 (if based on New York) to 1.26 (based on Seattle). This variation is primarily caused by differences in degree of accessibility, reliability, marketing, commitment by management and staff, etc. Given the uncertainty involved, using a range

Exhibit 8
Lift Usage Estimates for Chicago
Based on NCHRP 262

Step 1. Estimation of the Market

Chicago population	3,005,072
Population over 5 years	2,788,707
Severely mobility limited (0.97% - DPW)	27,050
Severely mobility limited with car (66% - DPW)	17,853
Severely mobility limited without car (34% - DPW)	9,197

Step 2. Estimation of trips

	With car	Without car	Total	Implied lift use rate
Market	17,853	9,197	27,050	
Current trip rate	0.9	0.6		
Total current trips	16,068	5,518		
Mode split for bus	0.03	0.081		
Trips on bus	482	447	929	0.41
New trip rate	0.006	0.042		
New trips	107	386	493	0.22
Diverted trip rate	0.014	0.14		
Diverted trips	225	773	998	0.44
Total lift trips	814	1606	2420	1.06

Source: McKnight, 1985.

Exhibit 9

Lift Usage Estimates for Champaign-Urbana
Based on NCHRP 262

Step 1. Estimation of the Market

MTD service area population	110,000
Population over 5 years	102,000
Mobility limited (3.9% - NCHRP)	3,981
Severely mobility limited (19% - NCHRP)	756
Severely mobility limited with car (69% - NCHRP)	522
Severely mobility limited without car (31% - NCHRP)	234

Step 2. Estimation of trips

	With car	Without car	Total	Implied lift use rate
Market	522	234	756	
Current trip rate	0.9	0.6		
Total current trips	470	141		
Mode split for bus	0.03	0.081		
Trips on bus	14	11	25	0.50
New trip rate	0.006	0.042		
New trips	3	10	13	0.25
Diverted trip rate	0.014	0.14		
Diverted trips	7	20	26	0.52
Total lift trips	24	41	65	1.27

Source: McKnight, 1985.

Exhibit 10
Transit Dependence and Service Reliability

System	Jobs in CBD	Passengers per peak bus	Revenue miles between roadcalls
Los Angeles	122,801	186,543	3063
New York	445,575	309,589	671
Seattle	51,781	84,500	3120
Oakland	29,011	175,383	6495
Denver	54,432	94,745	1965
Washington	124,510	126,179	1490
Eugene	10,772	76,278	1928
Champaign	6,629	78,919	2583
Chicago	276,235	244,296	3136

Source: Transportation Systems Center, 1983
Bureau of the Census, 1984.

of demand is more reasonable than trying to estimate an exact number. In choosing an appropriate range, it should be pointed out that many factors discourage demand from what it would be for a well run system; few, if any, would increase demand. Additionally, all the low rates in Exhibit 11 are based on systems that are not fully accessible. Thus, I chose a rate from about the middle of the estimates (0.30) to be the low end of the range and a one from the top (1.20) to limit the range on the high end. This rates would correspond with daily systemwide lift-user ridership of 680 to 2730 or 185,000 to 820,000 trips per year.

Champaign-Urbana had an initial lift-use rate of 0.29 (Rosenbloom, 1981) which rose to 0.39 in the fifth year. If this increase were to continue to the twentieth year (i.e., one generation), the daily lift-use rate would reach about 0.70. The current rate of 0.39 will be used as the lower limit to the range. This corresponds to a daily systemwide ridership of 20 to 36 or annual ridership of 600 to 10,700.

The NCHRP method (Wegmann et al., 1983) was used to estimate demand for special services (Exhibit 12). The CTA is currently operating a paratransit service for the disabled. Current demand is about 1400 per weekday (excluding attendants) with an eight hour reservation. Ridership increased about 50 percent in a five month period, after a major increase in capacity (see Roth and Marx, 1986) and is continuing to increase at about 3 percent per month. Thus, I chose 1500 trips per day as the low end of a range for demand for special services and 3500 (see Exhibit 12) as the high end. For Champaign-Urbana, I used 50 and 100 (average and high estimates from Exhibit 12).

At the end of the next section, these demand estimates will be used to compare unit and total costs of accessible fixed route bus to special services for a large and small city.

IV. <u>COST</u>

The cost of making a fixed route bus system accessible is a marginal cost. The significant ongoing costs are:

- Capital cost of lifts
- Maintenance of lists
- Driver training
- Insurance
- Administration
- Marketing

Some cost analyses have included costs for increased dwell time or additional buses to maintain seated capacity; however, no currently accessible system has found a need for these.

The above costs are a function of the number of lifts or the fleet size, not the number of lift users. Thus, the total cost of making a bus system accessible can be estimated independently of the demand for lift trips. The two major cost items are the capital cost of the lifts and their

Exhibit 11
Estimated Lift-Use Rates for Chicago
Based on Empirical Data

City	Daily lift use rate	Intensity: Passengers per peak bus	Ratio of Chicago to other city Intensity	Estimated Chicago daily lift use rate
Los Angeles	0.02	186,543	1.32	0.03
New York	0.03	309,589	0.80	0.02
Seattle	0.43	84,500	2.92	1.26
Oakland	0.19	175,383	1.41	0.27
Denver	0.10	94,745	2.61	0.27
Washington	0.05	126,179	1.96	0.10
Eugene	0.34	76,278	3.24	1.12
Champaign	0.39	78,919	3.13	1.25

Exhibit 12

Demand Estimates for Special Services
Based on NCHRP 262

	Trip rate per eligible person	Daily trips in Chicago	Daily trips in Champaign
Market (from Exhibits 9 and 10)		27,050	756
Low estimate of daily demand			
24 hour reservation	0.01	271	8
1 hour reservation	0.02	455	13
Average estimate			
24 hour reservation	0.07	1894	53
1 hour reservation	0.12	3182	89
High estimate			
24 hour reservation	0.13	3517	98
1 hour reservation	0.22	5909	168

Source: McKnight, 1983.

maintenance.

Capital cost. The cost of an installed lift (for a new bus, not a retrofit) varied from $5,700 to $15,000 for the period 1976 to 1979 (Middendorf et al., 1983). The current cost of an installed lift is about $11,000 to $12,000 (Smith, 1986). This includes the jump seats and tie downs as well as the lift itself. Assuming that buses have a 12 year life, the annual cost of a lift would be one twelfth of its purchase cost or about $1000 per year.

Maintenance Cost. Lift maintenance costs are highly variable; one source (Wegmann et al., 1983) listed costs from $162 (Detroit) to $4,200 (San Diego) per lift-equipped bus per year. They suggest using $650 per lift-equipped bus, which represents the cost at Champaign-Urbana, and also comment that there are learning curves for both the manufacturers (in making more reliable lifts) and for the maintenance personnel at the transit agencies. Seattle Metro's experience supports this; their maintenance cost has dropped from $542 per lift-equipped bus in 1982 (Municipality of Seattle, 1983) to $436 in 1983 and $355 in 1984 (Rosenzweig, 1985).

A planner at the Chicago Transit Authority estimates maintenance cost as a function of the number of mechanics needed per lift-equipped bus (CTA, 1984); this method has the advantage of allowing variations due to differing wage rates. The CTA estimate is one mechanic per 20 lift-equipped buses which at 1985 CTA wage rates is approximately $2,000 per bus. Eugene, Oregon, has two mechanics for 87 lift-equipped buses (Loobey, 1985). I believe that CTA's costs might be as high as $2000 per bus initially. However, with time the costs per bus would decrease due to improved lift technology and a learning curve for the mechanics. Thus, I estimated that after a 10 or 12 year period the CTA's maintenance cost per bus would decrease to about $500 per bus, slightly higher than Seattle's current costs. For the small transit agency, I used $650 (the Champaign-Urbana MTD's initial cost) initially and reduced it to $410 over 10 years; the final figure reflects the ratio of mechanics' wages for Champaign-Urbana and CTA (APTA, 1984).

Other costs. The costs for driver training and insurance are based on NCHRP report 262 (Wegmann et al., 1983). For administration for a large system, I assumed that it would require the equivalent of about one full time person and I estimated the cost at the CTA to be $50,000 per year. For Champaign-Urbana, which has a much smaller fleet and staff, I estimated a quarter full time person and reduced their cost by the same ratio as I used for mechanics wages. For marketing, I assumed a $50,000 a year budget for CTA and reduced it for Champaign-Urbana in the same ratio as the administrative costs.

Exhibit 13 presents the costs plus the total for making both the Chicago Transit Authority and the Champaign-Urbana bus systems fully accessible. The costs are for a time after the twelfth year when the total fleet is lift-equipped (assuming a twelve year fleet replacement cycle) and costs have stabilized. The capital cost of the lifts represents 55 percent of total cost for Chicago and 49 percent for Champaign-Urbana.

Exhibit 13

Cost of Making a Bus System Accessible

Large System: Chicago Transit Authority

Capital cost	$2,275,000
Lift maintenance	1,138,000
Driver training	569,000
Insurance	57,000
Administration	50,000
Marketing	50,000
Total annual cost	$4,139,000
Annual cost per lift-equipped bus	$1819

Small System: Champaign-Urbana Mass Transit District

Capital cost	$51,000
Lift maintenance	20,900
Driver training	10,200
Insurance	1,300
Administration	10,000
Marketing	10,000
Total annual cost	$103,400
Annual cost per lift-equipped bus	$2027

The cost per trip depends on the ridership. Given the range of demand developed in the previous section, the cost per trip for the CTA would range from $5.05 to $12.14. For Champaign-Urbana, cost per lift-user trip would range from $9.66 to $172.

There are many more special services in operation and therefore it is easier to estimate the cost for special services. Special services are labor intensive. The cost of the driver accounts for about 40 percent of the total cost. Administration, operation, and maintenance costs together, which are largely labor, account for close to 75 percent of total costs, while capital costs are generally 11 to 12 percent of costs (McKnight, 1985). Salaries and wages vary substantially with the size of the city and the size of the agency (Krouk and Morlok, 1983). Thus, the cost associated with special services are sensitive to location, while making a fixed route service accessible is not as sensitive to location because it is more capital intensive.

The CTA currently contracts for special service for individuals with disabilities at a cost of about $13.50 including the contract cost and the cost of administering the contract (Roth and Marx, 1986). Costs for special services in smaller cities tend to be lower because of the lower labor costs as discussed above. The Caravan system in Rockford, Illinios, provides a comparable operating environment to Champaign-Urbana. Their cost per trip in 1985 was $7.50 (Heineman, 1985). Part of the difference in cost is the difference in the cost of labor. An additional aspect is the difference in the length of trips in the different areas; large service areas tend to have longer trips which cost more to provide (McKnight, 1985).

Using the ranges in demand from the previous section, the total cost to the CTA for special services would range from $6,075,000 to $14,175,000. For Champaign-Urbana, the cost of a special service would range from $112,500 to $225,000 annually.

Exhibits 14 and 15 graphically compare the costs of the two solutions for the relevant ranges.

For Chicago (Exhibit 14), the total cost of a special service is higher than the cost of making the fixed route bus system accessible within the estimated ranges of ridership for the two systems. The cost per trip for accessible bus is lower than the cost on special services for the majority of the range of demand for fixed route bus. The break even point is about 300,000 trips per year on fixed route bus, which is a daily lift-use rate of 0.44 - approximately what Seattle experienced in 1984 with 50 percent of the fleet accessible. In a large city similar to Chicago, with its greater incentive to use transit, this rate can quite reasonably be expected to occur in a 12 year period with full accessibility.

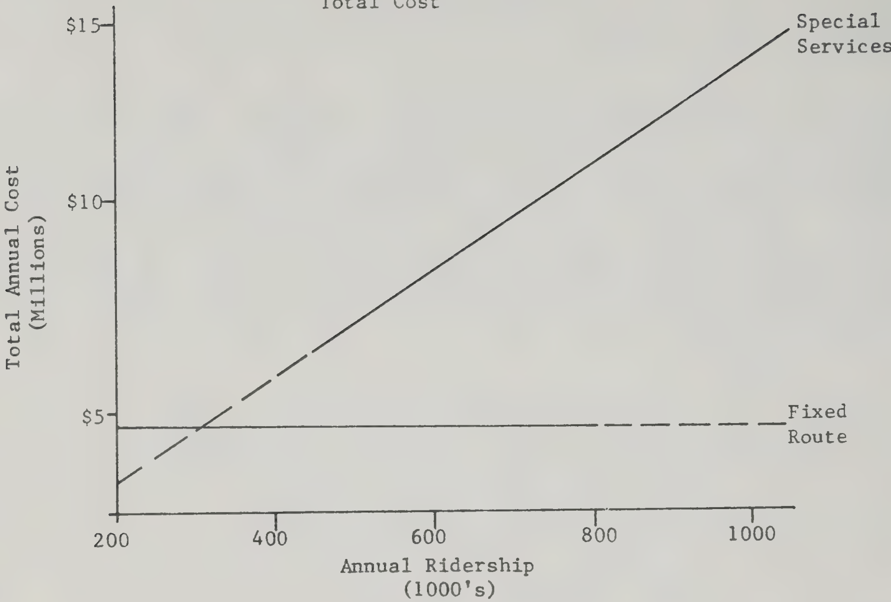
For Champaign-Urbana (Exhibit 15), the total cost of a special service would be greater than making the fixed route system accessible but the cost per trip for special services would be lower within the estimated ranges.

However, an accessible fixed route system, by itself, is a inadequate solution. As pointed out before, there is a proportion of the severely mobility limited who could not use an accessible fixed route bus because

Exhibit 14

Cost Comparison for Chicago

Total Cost



Cost Per Trip

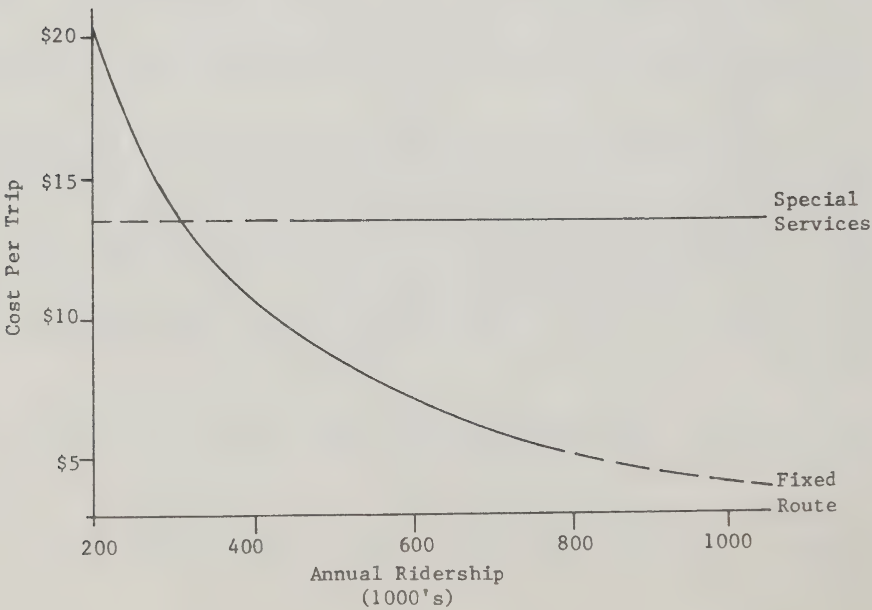
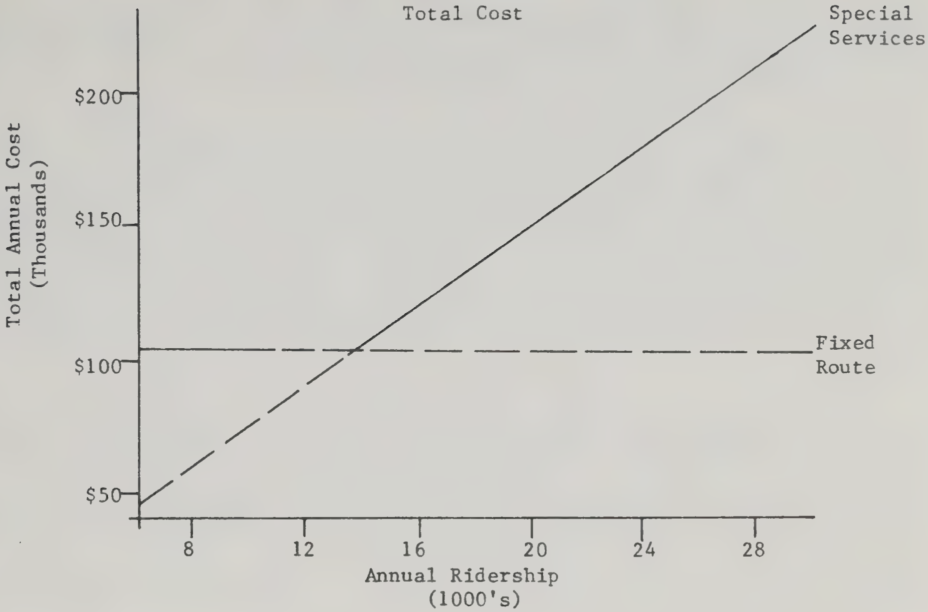
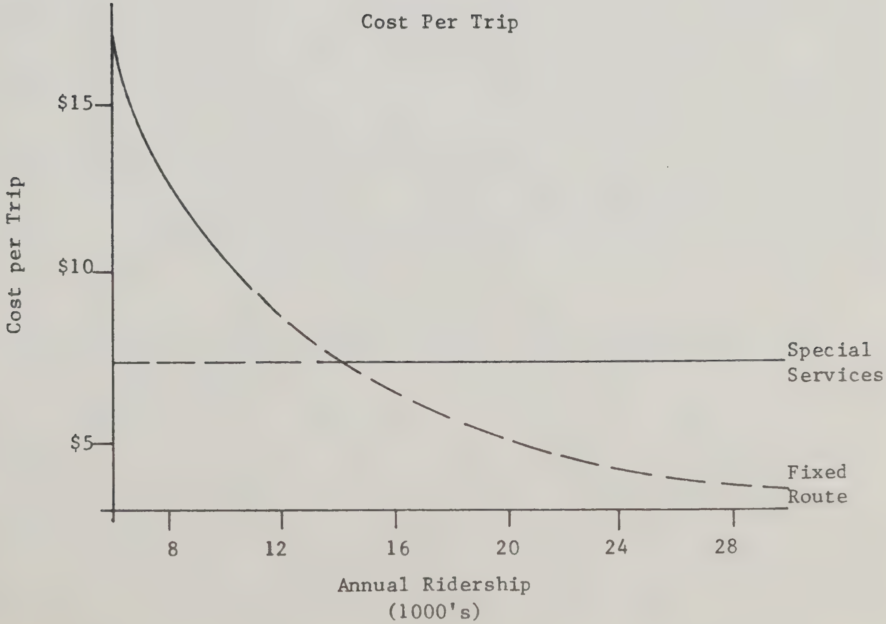


Exhibit 15

Cost Comparison for Champaign-Urbana





they can not get to the bus stop, move in crowds, etc. If an accessible bus system is implemented, serving the transportation needs of these people will require a special transportation system in addition. However, the total required capacity of the system should be less.

It is difficult to estimate the percentages of the mobility limited who would use the accessible system and those who would still need a special service. A survey conducted in Chicago (DPW, 1978) indicated that 90 percent of current non-transit users who could use a special service could also use an accessible system. The national survey (Grey, 1978) indicated the percentage would be only 30 percent. (This difference may reflect differences between Chicago, where the transit system is quite extensive and most people are familiar with it, and the average city , where the transit system is less extensive or may not exist and many people have never used it.)

Additionally, the trip rates for the two groups will probably differ; the disabled individuals who can and will use an accessible bus system are likely to be more mobile and independent than the disabled who need a special service. There are also indications that disabled users of fixed route transit are younger thatn the average disabled person. Thus, they are more likely to work, and work generates the largest number of trips of any purpose, plus work trips are more likely to be made by transit than other types of trips. Further the younger person is more likely to change habits in response to greater travel opportunities.

Rather than try to estimate the trip rates or the proportions in each group, I have made a rather simplistic assumption: The combined demand for trips on both systems is equal to the demand for special services. For purposes of this comparison, I let total annual demand in Chicago range from 500,000 to one million. I then determined the total and unit cost if 30 percent, 60 percent, and 90 percent of these trips are made on the fixed route system. Exhibit 16 graphically compares these costs to those for providing only a special service. As can be seen, the higher the total demand and the higher the proportion of total trips that is on the fixed route system, the better the multimodal option is in comparison to the special service. Also, for the majority of the total demand and diversion combinations, the multimodal system is less expensive both for unit and total cost. If the accessible bus users have higher trip rates than the average and the special service users have lower trip rates, as I suggest above, the cost advantages of the multimodal system are even greater.

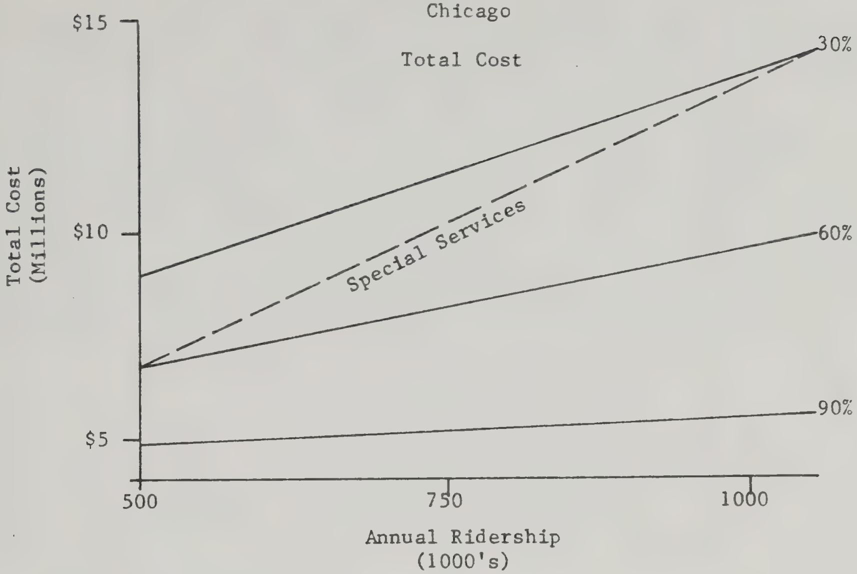
Exhibit 17 makes the same comparisons for Champaign-Urbana. In this case, the multimodal solution is less expensive only at high demand levels and high diversion rate. However, it is considerably less likely that a large proportion of the disabled would choose fixed route over special services or their automobile in Champaign. Auto-ownership rates in Champaign suggest less reliance on transit; 13 percent of all households in the Champaign-Urbana urbanized area do not have a car. In the Chicago urbanized area, 21 percent do not have a car; in the city 37 percent are without a car. Also the transit system in Chicago is more extensive than Champaign's relative to the size of the area. The ratio of vehicle miles to area for Chicago is 331; for Champaign-Urbana it is 88. The ratio of vehicle miles to route miles is 53,000 for Chicago and 8,700 for Champaign.

Exhibit 16

Multimodal Cost Compairsons

Chicago

Total Cost



Cost Per Trip

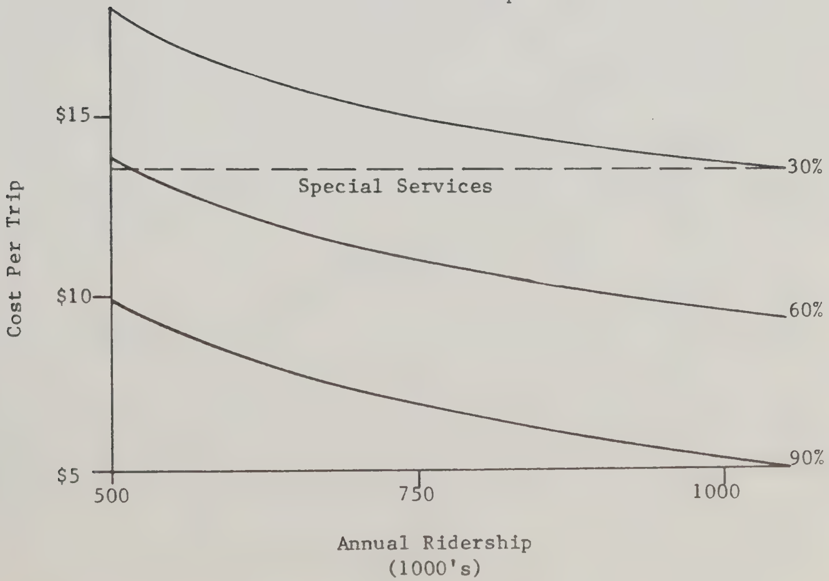
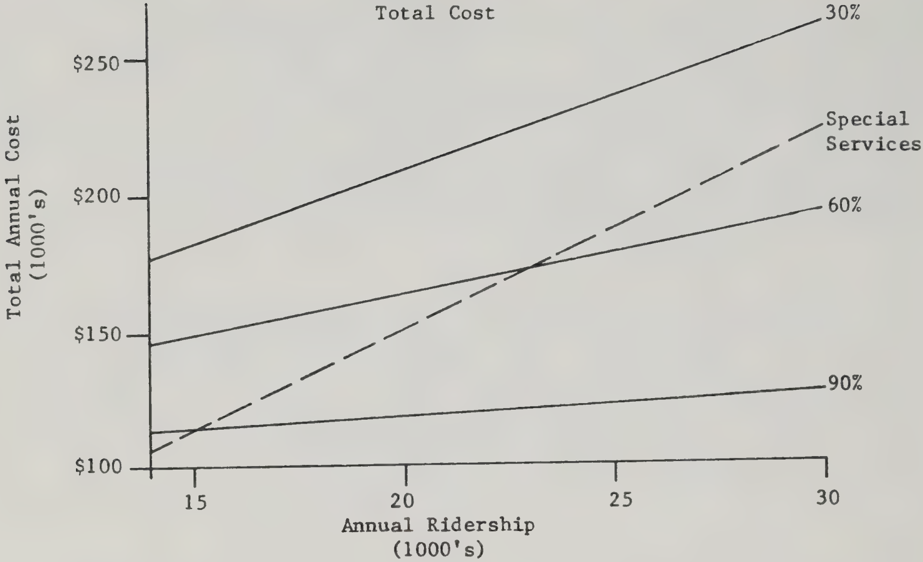


Exhibit 17

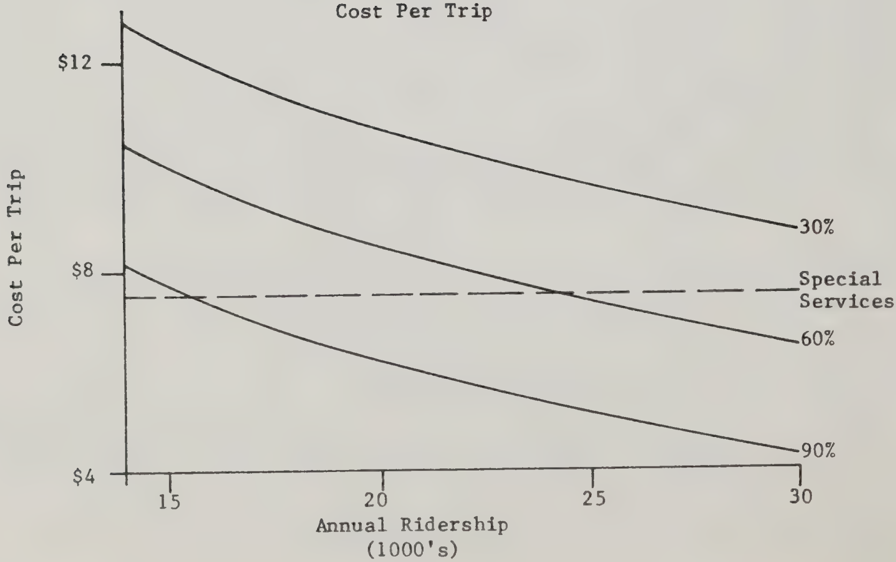
Multimodal Cost Comparisons

Champaign-Urbana

Total Cost



Cost Per Trip



Thus, in Chicago fixed route transit provides access to all parts of the city, frequent service, and 24 hour service. In Champaign-Urbana, the buses serve some sites well but others are not accessible by bus, the service is less frequent, and it does not operate past late evening.

The graphs indicate that in Chicago, a combination of accessible fixed route bus and special services would not only provide a better transportation system for the disabled but would probably be more cost-efficient. In the smaller city, a multimodal system would still provide a better system in the sense that it provides a choice; however, given the likely proportion of the disabled that would use the accessible bus system, it would be a more expensive solution than providing a special service with capacity ample to meet all the transportation needs of the disabled.

V. SUMMARY

This paper shows that, in a large, densely developed city with an extensive transit system, serving the transportation needs of the disabled by making the fixed route transit system accessible is liable to be more cost-efficient (in terms of cost per trip and total cost) than providing a separate special paratransit service. This remains true when the accessible bus system is supplemented with a paratransit service for those disabled individuals who cannot use a fixed route system. However, in a smaller city, or one less transit oriented, the special service will tend to be more cost-efficient.

There are several reasons for this. A large, densely developed city provides inherent incentives for using transit: heavy congestion, high parking costs, and high costs associated with owning a car. Such a city is more likely to have an extensive transit system, making it more feasible for individuals to rely totally on transit. These factors affect the disabled, just as they do the abled-bodied, increasing the proportion of the disabled that will use the transit system if it is accessible (relative to the proportion in a smaller city) and, more importantly to the cost comparisons, increasing the number of trips by lift-users per lift-equipped bus. another factor is that differences in labor costs have a larger impact on the cost of a special service, because it is more labor intensive than making a fixed route system accessible. Thus, a special service in a small city will be substantially cheaper than a similar service in a large city, while the cost per bus of making a bus system accessible will be about the same.

However, this analysis assumes that the agency responsible for a special paratransit system will provide enough capacity to meet all demand by the target group. It should be noted that one aspect of a special service that makes it appealing to the providing agency is that the total costs can be controled relatively easily; if the budget is strained, the total number of trips provided can be reduced. The remainder of the service maintains its effectiveness and quality. The costs of a fixed route system cannot be easily reduced without affecting the whole system.

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LE TRANSPORT

UN SERVICE SANS DISCRIMINATION NI PRIVILÈGE AU QUÉBEC

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Le transport:

Un service sans discrimination ni privilège au Québec

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La province de Québec est la plus grande province canadienne. Celle-ci est située à l'Est du pays et elle regroupe une population d'environ 6,5 millions d'habitants à très grande majorité de langue française.

Le territoire de la province est découpé en près de 1 500 municipalités dont la ville de Montréal qui a, à elle seule, plus d'un million d'habitants. En fait, seulement quatre (4) villes ont une population de plus de 100 000 habitants sur son territoire alors que 60% de toute la population du Québec vit dans des petites villes de moins de 10 000 habitants.

C'est donc dans ce contexte de dispersion au niveau géographique avec une seule grande ville, quelques villes de taille moyenne et une multitude de petites agglomérations que tous les partenaires intéressés à la cause des personnes handicapées ont publiquement reconnus, durant les années 1970, le retard considérable de la province en ce qui regarde la personne handicapée et son intégration scolaire, professionnelle et sociale à son milieu de vie.

C'est ainsi qu'en 1978, le gouvernement du Québec adoptait la Loi assurant l'exercice des droits des personnes handicapées. Cette loi constituait, entre autres, l'Office des personnes handicapées du Québec (OPHQ), organisme gouvernemental chargé de coordonner les services dispensés aux personnes handicapées, de promouvoir leurs intérêts et de favoriser leur intégration. De plus, cette même loi obligeait les neuf (9) organismes publics de transport en commun à offrir, sur leur territoire, des services de transport aux personnes handicapées. A remarquer que ces organismes publics de transport regroupent sur leur territoire plus de 50% des six millions et demi de québécois.

Devant la nécessité et l'urgence d'offrir aux personnes handicapées un degré d'autonomie et de mobilité équivalent à celui dont dispose la population en général, le gouvernement québécois optait et mettait sur pied en 1979 un programme d'aide à la création et au maintien de services de transport adapté "parallèle" aux services de transport régulier.

En plus d'aider financièrement les organismes publics de transport en commun à implanter et à développer un tel service pour les personnes handicapées, le programme permettait et favorisait aussi l'adhésion volontaire des autres municipalités du Québec. En destinant ainsi le programme aux municipalités, le gouvernement venait confirmer la responsabilité locale en matière organisation de services de transport.

Le programme d'aide gouvernemental consent aux organismes publics de transport et aux municipalités une subvention égale à 75% de tous les coûts du service de transport adapté. Le solde correspond à la contribution municipale et à celle de l'usager, dans une proportion d'environ 20% et 5% respectivement. Pour obtenir une telle subvention les organismes publics et les municipalités se doivent de présenter, au Ministre des transports, un plan de développement du transport adapté sur leur terrtoire visant un service sur une base minimale de cinq (5) jours par semaine. De plus, le tarif chargé à l'usager doit être équivalent à celui demandé par les services réguliers de transport en commun.

Le transport adapté au Québec est un service porte à porte sur demande, effectué par minibus et taxis selon un système de réservations préalables. Quelque 61 organismes de transport adapté ont été créés depuis la mise en place du programme en 1979. Ceux-ci desservent plus de 400 des 1 500 municipalités du Québec et regroupent près de 70% de la population québécoise. En 1985, les 20 000 personnes handicapées admises aux services de transport adapté ont effectué plus de 1 million de déplacements. Durant cette même année, le budget du ministère des transports consacré à ce programme a été de 12,5 millions de dollars.

Au Québec, ce programme ne dessert que les personnes handicapées et l'admissibilité de celles-ci est, depuis 1983, encadrée par une politique provinciale qui vise l'uniformité de l'admissibilité et l'intégration maximale de la personne handicapée à des services les moins spécialisés possible. Par exemple, l'utilisation du taxi est fortement encouragée maintenant.

La mise en place d'un système de transport adapté a aussi favorisé la création de regroupement d'usagers qui ont permis une meilleure perception des besoins et une meilleure allocation des ressources. De la même façon, la création du Comité consultatif provincial sur le transport des personnes handicapées ayant pour mandat de conseiller le Ministre des transports, a permis d'orienter les politiques du transport adapté.

En plus de ce programme de transport adapté parallèle, le gouvernement québécois s'est aussi préoccupé du transport des élèves handicapés dans le cadre du programme d'aide au transport scolaire. Ainsi, une allocation spécifique est prévue afin de permettre aux commissions scolaires d'acquérir des équipements et de fournir des services particuliers nécessaires au transport quotidien des écoliers handicapés. En 1985, le gouvernement québécois a consenti une enveloppe budgétaire de 12,0 millions de dollars à cet effet.

Le gouvernement du Québec a aussi réalisé diverses actions visant à faciliter la mobilité des personnes handicapées notamment, en ce qui a trait à l'obtention du permis de conduire et à l'adaptation des véhicules privés, à l'accessibilité des haltes routières, à l'amélioration des équipements maritimes propriétés du Québec. De plus, la collaboration du ministère des Transports avec l'entreprise privée afin d'améliorer les services de transport interurbain par autocar et l'amélioration des systèmes de transport régulier sont autant d'initiatives entreprises pour faciliter l'intégration des personnes handicapées aux activités de leur milieu.

Le programme actuel de transport adapté a répondu aux besoins de la majorité des personnes handicapées des grandes agglomérations québécoises. Par contre, il reste certaines clientèles plus

dispersées notamment dans les municipalités rurales, pour lesquelles de nouvelles possiblités d'aide sont actuellement à l'étude, de façon à permettre à cette clientèle l'utilisation de services plus souples et conformes à leurs besoins que les services actuels avec minibus, service de répartition et comité d'admissibilité.

D'autre part, le développement de mécanismes d'échange de services (réciprocité) entre les organismes de transport adapté et la mise en commun des services dans le but de maximiser les ressources existantes sont envisagées.

L'accroissement rapide du nombre de minibus adapté au Québec au cours des dernières années a soulevé avec acquité le problème de la sécurité et de l'utilisation de ces véhicules. Le ministère des Transports procédera donc à la consultation de tous ses partenaires impliqués au cours des prochaines semaines concernant un avant-projet de règlement sur les normes de sécurité et d'utilisation de ce type de véhicules. Cette réglementation pourrait être en vigueur au début de 1987.

Les personnes à mobilité réduite, qui sont inadmissibles au transport adapté, rencontrent elles aussi de nombreuses difficultés à utiliser les systèmes d'autobus réguliers, de train ou de métro. De concert avec les organismes de transport, le ministère des Transports est à développer un ensemble de normes applicables à l'achat d'autobus neufs, à l'adaptation des véhicules (autobus et métro) de transport régulier et à la réalisation de projets de construction de stations de métro de façon à les rendre plus accessibles à cette partie de la population.

C'est donc par un élargissement du concept de mobilité pour les personnes handicapées et l'élaboration de moyens novateurs et plus souples que le gouvernement du Québec en termes de transport, a amorcé une révision de sa politique d'accessibilité aux personnes handicapées qui repose sur le principe "sans discrimination ni privilège pour les personnes handicapées".

GILLES CLOUTIER
Québec, 17 juin 1986

GC/hb

PROVIDING PUBLIC TRANSPORTATION FOR DISABLED PERSONS IN AMERICA'S LARGEST CITIES

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INTRODUCTION

Despite the continual changes and uncertainty in federal transportation policies and regulations regarding disabled persons over the past dozen years, a variety of innovative public transportation approaches have been implemented and evaluated in major cities across the U.S. Some of the systems that are widely regarded as successful include those in Seattle, Pittsburgh, Milwaukee, Portland, Champaign-Urbana, and San Diego. (See Fix, et al. (1985))

America's largest cities, on the other hand, have moved more cautiously in developing comprehensive services for the disabled. Due to the changing federal regulatory requirements and the size and complexity of their public transportation systems, New York, Boston, Philadelphia, Washington, D.C., Detroit, Chicago, and San Francisco have only in recent years begun to implement or expand services for the disabled aimed at attaining comparability with services available to the general public.

In this paper we review the services for disabled persons in a cross-section of the largest U.S. cities and compare the programs along three dimensions: service levels, mobility impacts, and cost-effectiveness. Based upon these assessments, we identify the salient problems and issues facing the larger cities. (See Miller (1985))

A main issue identified is that local decision makers are still unsure about what should be considered adequate. The Final Rules issued recently by the U.S. Department of Transportation (1986) have reduced the long-running uncertainty about the requirements associated with federal financial assistance. Even with the increased flexibility and the limit on required expenditures provided in these rules, however, the largest cities still face some difficult choices in making their disabled services comparable with those available to the general public.

The 1986 U.S. DOT Rules explicitly recognize the "variety of different local conditions, preferences, and programs" for the disabled, and "the difficulty of forcing all these differing situations into a single, made-in-Washington mold." While the rules provide a set of minimum criteria for cities to meet, they leave many of the difficult trade-offs between the various dimensions of service quality and costs to local discretion. We suggest that the most promising source of guidance for decision-makers in making these trade-offs is the evolving experience in other large cities, and in the several medium-sized cities that have already developed successful programs for the disabled.

OVERVIEW OF SERVICE IN SIX MAJOR CITIES

Boston, Philadelphia, Washington, D.C., Detroit, Chicago, and San Francisco represent a cross-section of older, larger U.S. metropolitan areas in the East, Midwest, and West. These cities cover broad ranges of the demographic and transportation characteristics of the largest urban areas and have quite different approaches to serving the disabled.

Fixed-Route Services

The main characteristics of the fixed-route services in each city are presented in Exhibit 1. All of the cities have extensive bus systems, and all except for Detroit have rail transit services. The transit agencies in Boston, Philadelphia, and Chicago also operate commuter rail services. Three of the systems serve central cities and suburbs in very large regions (over 1,000 square miles) while two serve large urban areas (over 800 square miles). Only San Francisco's system is geographically limited to the central city.

All of the cities have some degree of wheelchair accessible fixed-route services. Only Philadelphia and San Francisco, however, have more than 20 percent of their bus fleets accessible. Only Washington, D.C. and San Francisco have truly accessible rail transit systems. Four of the cities offer greater fare discounts than just half price during the peak periods.

The limited information on usage by wheelchair users indicates that the systems serve very few people each month. San Francisco's bus usage is the highest and has been increasing significantly. Washington's "On-Call" bus service and rail transit system report the next highest monthly ridership. Boston is considering introducing an on-call bus service like Washington's. Detroit, on the other hand, is struggling to maintain its very limited accessible service in the face of state and local financing problems affecting its entire transit system.

Paratransit Services

All of the cities except Washington, D.C., have door-to-door paratransit services sponsored by their transit agencies. The services in Boston, Chicago, and San Francisco are available only to persons certified as unable to use regular fixed-route services. The Philadelphia system is available to certified disabled persons (who pay a $1.25 fare) as well as senior citizens (who pay a fare of $1.80) and the general public (who are charged $18.00 a trip). The Detroit system serves elderly and disabled persons primarily, but accommodates the general public on a limited basis.

Five service features of each paratransit system, as operated in September 1985, are shown in Exhibit 2. These service characteristics vary widely from city to city reflecting how the systems have evolved to meet different local objectives. Four of the five systems serve the central city primarily. In Detroit's case, however, the paratransit service operates mainly in the suburban counties. San Francisco generally has the lowest fares, particularly for the monthly pass users and low income persons who qualify for the 90 percent taxi fare discount. Philadelphia has the highest fare per trip and Detroit and the San Francisco taxi system have the only distance-based fare systems.

The major program characteristics of the five paratransit systems are shown in Exhibit 3. These characteristics also vary greatly between urban areas. While Detroit reports the highest monthly ridership and annual budget, the bulk of these trips are in the suburbs and include some 40 percent non-disabled (i.e., elderly and

Exhibit 1: Program Characteristics of Fixed-Route Services

	Size of Urbanized Population (Area)	Wheelchair Accessible Service	Monthly Trips	Unique Fare Aspects	Plans
Boston	2.7m (850 sq. mi.)	• 8% of buses • 10 bus routes • 5 transit stations • some rail stations	"very low"	None	• Considering day-in-advance reservation buses • 50% of new buses to have lifts • 60% of transit stations accessible by 1988
Philadelphia	3.7m (2000 sq. mi.)	• 20% of buses • 20 bus routes • 7 transit stations • 17 rail stations	about 30 on buses	None	• Future bus purchases will not have lifts
Washington, D.C.	2.7m (800 sq. mi.)	• 14% of buses • 10 bus routes • day-in-advance buses • 100% transit	1300 on buses	Reduced (often half) fares all times with ID	• Conducting study to determine policy
Detroit	3.8m (1000 sq. mi.)	• 16% of buses • no bus routes • day-in-advance buses in suburbs	60 trips/ month in suburbs	Blind and elderly free within city	• Depend upon solving system fiscal problems
Chicago	6.8m (1500 sq. mi.)	• 0% of buses • 13 transit stations • 40 rail stations	"very few"	Half fares all times with ID	• Gradually add accessible stations and cars
San Francisco	0.7m (46 sq. mi.)	• 40% of buses • 12 bus routes • 100% subway stations • 3 surface stations	50 on buses	5 cents/ride or $2.50 monthly pass	• Gradually add new lift buses accessible surface stations

Exhibit 2: Paratransit Service Characteristics

	Area Served	Fare	Hours of Operation	Advance Reservations	Restrictions on Travel
Boston	Central City + 13 suburbs	$.75	7 am - 11 pm M-Th 7 am - 1 am F-Sa 9 am - 12 am Su	3 days	o Priority for non-ambulatory o Subscription trips limited
Philadelphia	Central City + 6 major sites in suburbs	1.25	6 am - 10 pm M-F 8 am - 12 am Sa 9 am - 5 pm Su	2-7 days	Subscription trips limited
Detroit	Suburbs + portions of Central City	.75 plus zone charge	7 am - 5:30 pm M-F	1-2 plus days	o Subscription trips limited o Priority for social service agency trips
Chicago	Central City	.90 18/month	6 am - 9:30 pm M-F[a] 9 am - 5 pm Sa, Su[a]	1 day[b]	Subscription trips limited
San Francisco	Central City + Airport	.40 4.50/month 90-50% taxi fare discount	7 am - 11 pm M-Su-Vans 24 hours - taxicabs	1 day plus-vans Immediate - cabs	o Waiting lists for both taxis/vans o Priority for non-ambulatory and medical trips o Subscription trips limited

a Changed to 5:00 a.m. - 1:00 a.m. every day in November 1985
b Changed to 8-24 hours in November 1985

Exhibit 3: Program Characteristics of Paratransit Services

	Monthly Ridership (% wheelchair)	Annual Budget	Transit Agency Involvement	Private Sector Involvement	Social Service Agency Financial Involvement	Primary Demand Management Strategies	Plans
Boston	12,000 (45%)	$2.4m	• Policymaker • Funder	• Non-profit administrator and operator--provider side subsidies	None	• Long advance reservations • Priority to non-ambulatory • Limit subscriptions • Serve near suburbs	• Expanding to 36 suburbs • Implementing computer-assisted scheduling
Philadelphia	14,000[a] (25%)	$4.0m	• Policymaker • Funder • Administrator[c]	• Profit and non-profit providers operate--provider-side subsidies	Very Limited	• Long advance reservations • High fare • Limit subscriptions • Don´t serve suburbs	• Implementing computer scheduling
Detroit	50,000[b] (5%)	$5.4m	• Policymaker • Funder • Administrator • Operator	• Some taxi user-side subsidy programs in suburbs	Some	• Limit service hours • Limit subscriptions • Deny trips • Limited service in Central City	• Seeking funding sources
Chicago	12,000 (45%)	$4.0m	• Policymaker • Administrator • Operator[d] • Funder	• Profit and non-profit providers operate--user-side subsidies[d]	Some[d]	• Limit subscriptions • Don´t serve suburbs • May set daily trip limits	• Expect new system to expand hours of operation, service area, and capacity
San Francisco	25,000 (30%)	$2.2m	• Policymaker • Funder	• Non-profit administration • Profit and non-profit operate vans--provider-side subsidies • Taxicabs--user-side subsidies	Agencies Sponsor Group Vans	• Waiting lists • Limit subscriptions • Priority for non-ambulatory • Don´t serve suburbs	• Seeking funding sources

a Elderly also
b Elderly and General Public
c As of July 1, 1985
d Changed November 1985

general public) travelers. Only about ten percent of the trips are within the city, and only five percent are by persons in wheelchairs. San Francisco reports the highest monthly ridership and lowest annual budget of the systems serving only disabled persons. Boston, Philadelphia, and Chicago all report about the same monthly ridership. Boston's annual budget, however, is about half of both Philadelphia's and Chicago's. Both of these latter systems are modifying their programs to increase their ridership.

The roles of the transit agencies and the private sector differ significantly across the cities. In all cases the transit agency is the policymaker and the primary funding agency. In Philadelphia, Detroit, and Chicago, the transit agencies also administer the systems. A nonprofit organization in Boston and a for-profit organization in San Francisco administer their systems.

When Chicago introduced its user-side subsidy system in November 1985, Detroit became the only system with paratransit service operated directly by a transit agency. For-profit taxicab and other carriers as well as nonprofit providers are involved in the systems in Philadelplhia, Chicago, and San Francisco. Only a single nonprofit provider operates Boston's services, however. The new Chicago system and the taxicab component of San Francisco's system involve the user-side subsidy approach. Boston, Philadelphia and the lift-van component of San Francisco's system have provider-side subsidies for the private carriers.

COMPARING THE SIX PROGRAMS

Exhibit 4 examines how the programs in the six cities compare qualitatively with their general public counterparts along the six service level dimensions included in the 1986 DOT Final Rules. No attempt was made to address any of the other significant dimensions such as reliability, user safety, or total travel time, however. These latter comparisons would require more data on the actual service performance experienced by users than any of the current programs have assembled to date.

It is clear from this comparison that none of the disabled services is completely comparable to its general public counterpart. The combination of fixed-route and paratransit services in <u>Boston</u> matches its general public counterpart only in some respects. The fixed-route bus and transit services are not very similar in terms of geographic coverage, time availability, or vehicle and station accessibility. The off-peak fares are lower, however. For the paratransit service, the geographic coverage does not include most of the suburban areas, the time availability is limited, and three days advance reservation is required. The fare is the same as the general public system.

In <u>Philadelphia</u>, the combination of fixed-route and paratransit services is not very comparable with its general public counterpart. The fixed-route services fall short in terms of vehicle and station accessibility, geographic coverage and time availability. The off-peak fares are lower, however. For the paratransit service, the

Exhibit 4: Service Levels for Disabled Persons Compared with Service Levels for the General Public

	(1) All Physically Disabled Eligible?	(2) Waiting Time Greater Than 24 Hours?	(3) Trip Restrictions	(4) User Fares	(5) Time Coverage	(6) Geographic
Boston	Yes	Yes	new subscription trips on paratransit limited	Lower	Smaller	Smaller (some suburbs)
Philadelphia	Yes	Yes	new subscription trips on paratransit limited	Higher	Smaller	Smaller (some suburbs)
Washington, D.C.	Yes	No	None	Lower	Same	Same (with day before reservations)
Detroit	Yes	Yes	new subscription trips on paratransit limited	Lower	Quite Small	Smaller
Chicago	Yes	No	new subscription trips on paratransit limited	Same	Smaller	Smaller (some suburbs)
San Francisco	Yes	No	waiting lists for paratransit; new subscription trips limited	Lower	Smaller	Same

geographic coverage does not include the large suburban counties, the time availability is limited, two to seven days advance reservation is required, and the fare is higher than the general public system.

While the lift-equipped bus services and the accessible transit system in Washington, D.C., are the same as their general public counterparts in several respects, the bus services differ significantly in several ways. Advance reservations are required to obtain a lift-bus on all but about ten routes, and even on the accessible routes the lift-equipped buses are scheduled at longer intervals than their regular counterparts. Significant fare discounts are offered to disabled persons, however. No paratransit services are sponsored by the transit agency for disabled persons within the central city or suburbs. While the Washington, D.C., system does well with respect to the criteria in Exhibit 4, there is some question as to the ability of the system to actually deliver the services advertized, particularly if a number of geographically diverse service requests are received on the same day. Further, the exclusive focus on fixed-route services means that persons unable to reach the bus routes are simply not accommodated.

In Detroit, the combination of fixed-route and paratransit services is limited and varies from the central city to the suburban counties. Taken together the services compare unfavorably with their general public counterpart in several respects. Within the City of Detroit, the fixed-route service falls short in terms of vehicle accessibility, geographic coverage, and waiting time. (Its major difficulty, however, is poor lift reliability.) Within the suburbs, the geographic and time coverage of the fixed-route service are comparable to general public services, though advance reservations are required. The off-peak fares are lower. The paratransit service has a somewhat limited geographic coverage and a one, two or more day advance reservation requirement. The time availability is quite restrictive compared to the fixed-route services. The fares are lower, however.

Although Chicago has some accessible transit stations, paratransit is the only service available to most disabled persons. The paratransit service does not match its general public counterpart very well except for fares. The geographic coverage does not cover the suburbs, the time availability is lower, and advance reservation is required.

In San Francisco, the combination of accessible fixed-route bus and rail transit with paratransit services gives a system somewhat comparable to its general public counterpart. Several significant different service quality aspects exist, however. While all of the underground rail transit stations are accessible, only a few of the light rail surface stations are, and only 12 of the bus system routes have lift-equipped vehicles. The user fares are significantly lower, however. For the paratransit services, the taxicab component is performing very well except for the long waiting list restrictions for new users and the variable fares. The lift-van service also has a waiting list. It falls short in terms of the advance reservation requirement and smaller time availability but offers much lower fares.

Finally, while none of the paratransit services imposes trip purpose restrictions directly, they all have some trip priorities and limitations resulting from capacity limitations. For example, they all restrict new requests for recurring trips, and some services give priority to non-ambulatory users.

ISSUES FACING LARGER CITIES

Service Level Concerns

In all six cities, the transit agencies have moved slowly and reluctantly to make a significant portion of their existing fixed-route bus or rail transit services truly accessible for all disabled persons. Even though Michigan and California state laws mandate that all buses be equipped with lifts, the systems in Detroit and San Francisco are implementing accessible bus service slowly as new vehicles are purchased and older vehicles (including some with severe lift maintenance problems) are replaced. Washington, D.C., and Boston have relatively small percentages of their buses accessible at present, but are planning to add more accessible buses gradually as they acquire new equipment. Philadelphia seems to have decided against making more buses accessible, concentrating instead on its paratransit program. Chicago appears to be completely opposed to making its buses accessible, and is devoting all of its resources to its paratransit program.

Most of the largest cities have embarked upon a paratransit approach either as the primary service or in combination with fixed-route efforts. While most of these paratransit systems charge fares comparable to general public services, all currently lack the capacity to serve vast suburban areas, to offer long service hours, or to provide timely, unrestricted access to all of the disabled travelers in their regions. From a user perspective, other important service quality aspects such as total trip time, reliability, on-time performance, and convenience of travel may not match very well with services available to the general public.

Exhibit 4 suggests that with the possible exception of Washington, D.C., all of the largest cities fall short of one or more of the service criteria specified in the 1986 DOT rules. The cost limit of 3 percent of operating costs specified in the 1986 DOT rules provides a constraint on the cost exposure of all federal recipients in complying with the rules. While data on the current disabled expenditures of larger cities relative to their total operating costs are not yet available, initial indications are that at least some cities will be well short of the 3 percent limit. Shortcomings relative to the criteria in Exhibit 4 therefore will have to be addressed, at least until the cost limit is reached.

The 1986 DOT rules take the optimistic view that "many recipients are likely to be able to comply for less than their 'limit' amounts...particularly...recipients in larger cities." The data on which this optimism is based did not include all the cities discussed in this paper, however. If the six service criteria in Exhibit 4 are interpreted strictly, and reliability and other service performance measures are taken into account, the largest cities are likely to face major challenges in reaching compliance with the new DOT rules.

Mobility Concerns

Since few of the largest cities have truly accessible and reliable fixed-route services, current usage (both number of users and the amount of tripmaking) by disabled persons is quite low. On the other hand, when the largest cities offer paratransit services, the usage by all types of disabled persons is not only high, but has to be constrained or rationed because of limited capacity. The challenge is how to respond adequately to the mobility needs of all eligible disabled subgroups, whether they are non-ambulatory, ambulatory, occasional users, or affiliated with social service agencies.

The paratransit systems also have experienced quite high demand by relatively small numbers of disabled persons who request subscription service for their regular travel. Because of limited capacity, most systems try to limit how much subscription travel to serve. Systems also often have experienced large demand by clients of social service agencies. Again, due to capacity limitations, most systems try either to get social service agencies to contribute to the funding of their services or to restrict the amount of agency travel served. The basic dilemma for the paratransit systems is that when they offer good mobility for disabled persons, they are often swamped with demand and are forced to constrain usage.

Cost-Effectiveness Issues

No large city has committed the resources necessary to offer paratransit services to all eligible users at the levels implied by the criteria contained in the new 1986 DOT rules. In fact, as discussed above, the paratransit services have had to be rationed either directly or indirectly.

In addition to rationing or managing demand, the systems also are trying to expand system capacity in several ways. All are seeking more local and state funding. Some are making major attempts to improve their administration and to better utilize private carriers. A basic administrative issue concerns the role of the transit agency: should it contract for a private management organization or manage the system itself? For some cities, a related issue concerns the effectiveness of new computer systems for call-taking, dispatching and scheduling, or performance monitoring. Will new computer technology work at the larger demand and geographic scales found in the largest cities? And will the service quality and productivity improvements be worth the installation and ongoing costs?

It is becoming increasingly common for larger cities to look to the private sector to operate their paratransit services. A basic objective here is to ensure that service quality is high while provider costs remain competitive. Cities are pursuing this objective by developing administrative arrangements that will promote real and continuing competition between providers (both for-profit and nonprofit) at low administrative cost.

TOWARD BETTER PUBLIC TRANSPORTATION FOR THE DISABLED

Policy makers in the largest cities face a difficult task when they seek to provide good public transporation service for their disabled citizens. Due in part to changing federal regulatory requirements, many of these policy makers have been reluctant to make significant long-term commitments to truly comparable, quality services for all disabled persons. The sheer size of their service areas and populations makes service design a major challenge. Further, all of the cities have cost and budget pressures associated with their general public services, and are hard-pressed to make the major funding commitments needed to provide adequate mobility to their disabled residents.

The 1986 DOT Final Rules require the largest cities to gradually improve their disabled services over a six-year phase-in period. The rules do not provide a blueprint, however, for the specific types of services and expenditures that these cities should undertake. Each city must make major decisions of its own within the framework provided by the rules. If current services are any guide, it seems likely that these decisions will be taken differently in different cities.

It will be possible for the services in some cities to comply with the new DOT rules, but still provide poor quality services for vast numbers of disabled individuals. As an extreme example, in a large urban area, poor fixed-route accessible bus service could be offered to inner-city residents while extensive paratransit or fixed-route services are available for suburban residents. Calls for adequate inner city service could be ignored if the costs of the suburban services exceed the federal cost limit for the entire system. In another metropolitan area the opposite could occur, with very poor services for suburban residents because of major expenditures on inner city services.

Even cities that meet the service criteria in the DOT rules may still be capable of great improvements. Some improvements would benefit disabled persons directly by affecting their actual service quality or increasing the capacity so that more trips can be made. Improving the efficiency of the service provision would reduce costs and lessen pressures for more public subsidies. An obvious issue for cities like Washington, D.C., that may meet the rules solely through accessible fixed-route services is whether or not any provision should be made for disabled persons who need door-to-door service.

Rather than relying on the DOT Rules to guide the development of their disabled services, we suggest that the largest cities could derive their performance standards largely from the actual accomplishments of other cities. Under this approach, local governments in direct consultation with the disabled community would select a single programmatic and performance model, chosen from several well-documented examples of successful services. These examples would reflect a wide range of demand, supply, and social conditions drawn from cities with fixed-route, paratransit, and "hybrid" service alternatives. Local governments would then focus their efforts on implementing services that conform to the performance levels in their selected model within a reasonable period of time.

This approach has two primary advantages. Since the models would be drawn directly from the operating experience of cities, they would incorporate the real-world trade-offs which economic and political forces dictate. Meeting the performance levels would be manifestly "doable" rather than just hopeful planning. In addition, because the performance levels would be based upon "living" models, they would not be closed-ended, but rather could incorporate successful new service or program innovations as they occur around the country.

This process of planning by analogy and adaptation is already occurring to some extent. Chicago based its recently revamped paratransit service in part on successful systems in Milwaukee and Pittsburgh, for example, and Boston is currently considering the development of on-call accessible bus services like those in Washington, D.C. As disabled services expand and improve, cities can learn from each other not only on program design features, but also on techniques for improving cost-effectiveness. Innovations in computer call-taking and dispatching, and new procedures for cost-sharing with social service agencies might well be transferable, for example.

Eventually, a range of exemplary models should evolve for cities of all sizes. Choosing realistic performance levels for public transportation along these lines will enable local policy makers, planners and special service managers to concern themselves with what is actually being accomplished for disabled persons in terms of overall service quality and utilization, rather than just maneuvering to satisfy a set of abstract federal requirements.

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IMPROVING TRANSPORTATION FOR ELDERLY AND DISABLED PERSONS THROUGH THE EDUCATION OF OPERATING AND MAINTENANCE COSTS

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IMPROVING TRANSPORTATION FOR ELDERLY AND DISABLED PERSONS THROUGH THE REDUCTION OF OPERATING AND MAINTENANCE COSTS

Introduction

An innovative Program was conducted in North Carolina through The University of North Carolina Institute for Transportation Research and Education (ITRE), with the objective of influencing and improving mobility and transport for elderly and disabled (and low income) persons, by reducing operating and maintenance costs. That Program was "Van Care Clinics for Energy Efficiency," part of a Vehicle Maintenance Public Awareness Program funded by the Energy Division of the North Carolina Department of Commerce.

Nine Van Care Clinics were conducted throughout the state from May through September, 1984, in coordination with Car Care Clinics that were conducted through ITRE by the Independent Garage Owners of North Carolina, and in cooperation with the North Carolina Department of Transportation, Public Transportation Division.

All public, private non-profit and private van transportation service providers in the state were invited to participate in these free Van Care Clinics, which were conducted on Fridays and Saturdays at major shopping centers and consisted of two parts: (1) Diagnostic testing of vans and (2) A workshop to train van service provider personnel.

This paper addresses the following elements of that Program:

I. Scheduling, Site Selection and Workshop Space

II. Publications and Information: Workshop Packets

III. Publicity and Registration

IV. Conduct of the Van Care Clinics

V. Results

VI. Evaluation

VII. General Application

Scheduling, Site Selection and Workshop Space

Scheduling and site selection for the Van Care Clinics were guided by the criteria of cities with significant populations, wide geographic distribution and concentrations of van transportation service providers. Obtaining workshop space was guided by the criteria of being in close proximity to the Car Care Clinics and having adequate space to accommodate the participants and audio-visual equipment. The first Clinic began in May with the observance of National Transportation Week.

The Van Care Clinic Program was coordinated with the Car Care Clinics so that van transportation service providers could have their vans tested at a Car Care Clinic on either a Friday or a Saturday, and their personnel trained on a Saturday.

Publications and Information: Workshop Packets

Existing phamplets, brochures and other material on energy savings were reviewed to determine the best and most cost-effective information available on energy efficient vehicle driving and maintenance techniques. These were part of a packet of information that was given to and reviewed with each workshop participant.

Van Care Clinic Workshop packets included the following:

1. "Driving Efficiency Quotient (DEQ)" test on the "Featherfoot" film of the American Institute of Driving Efficiency.
2. "Routes to Fuel Economy" as produced by ITRE.
3. Shell Answer Book #31 - "The Longer Car Life Book".
4. Shell's "Question & Answer Guide to Heavy-Duty Motor Oils."
5. A "Fixed and Variable Costs Budget Sheet" (example).
6. An "Annual Individual Equipment Record" (example).
6. Preventive Maintenance (PM) Program checklists.
7. An "Informational Memorandum" with a sample calculation of estimated energy savings.
8. A "Description of DRIVEC."
9. A "Van Care Clinic Workshop Evaluation Form."

Each agency was later furnished with additional instructional and administrative information. These were: (1) "A Guide to Planning your Transportation System for Energy Conservation" and (2) DRIVEC (Driver/Vehicle Economy and Conservation) Instructors Training Manual.

Publicity and Registration

All North Carolina rural and urban public, private non-profit (human service agency) and private (taxicab company and vanpool program) van transportation service providers were invited and encouraged to participate in the Van Care Clinics.

A comprehensive mailing list of van transportation service

providers was developed and publicity and pre-registration forms were sent to those providers, including a letter explaining the Van Care Clinics, a schedule of the Clinics and a "Census of Vans" form. These were directly mailed to 230 van transportation service providers, as follows:

- 180 rural van agencies and organizations
- 14 urban van agencies and van pools
- 36 taxicab companies and privately organized van pools

Modified publicity and pre-registration forms, along with the mailing list of the above 230 "direct contacts," were mailed to 45 other agencies, requesting their assistance in contacting the above and any other van transportation service providers in their area. The 45 "indirect" contacts were:

- The 16 regional public agencies (COGs)
- 19 county managers
- 10 other county transportation contacts

This initial publicity, follow-up publicity, referrals and interest generated through other publicity eventually resulted in a total of 278 direct contacts, from which there were 114 total responses (a 41% response rate). Seventy (70) of the 101 providers responding indicated they would participate in the Van Care Clinics (25% of total contacts and 61% of total responses). They accounted for 413 vans and indicated they would have 193 vans tested and 245 personnel trained. Of the remaining 44 total responses, 31 were providers who said they would be unable to participate for various reasons (too far to travel, could not participate on a Saturday, had adequate maintenance, etc.). They accounted for 121 vans. The other 13 responses were 10 not owning or operating vans and 3 mailings returned.

The majority of the 164 non-responses were agencies and organizations that either did not provide van transportation services or provided them to a limited degree. The accounting for 534 vans in the "census" confirmed this, as it was estimated by the DOT's Public Transportation Division (DOT/PTD) that 500-600 vans were operating in North Carolina.

Finally, a registration package was developed for the Van Care Clinics. This was periodically (two weeks prior to specific Clinics) distributed to pre-registered van transportation service providers. ITRE and the DOT/PTD followed-up on these registrations in an attempt to get good participation in the Clinics.

Conduct of the Van Care Clinics

Van Care Clinics, held at nine (9) locations throughout North Carolina on Fridays and Saturdays from May 18 through September 8, 1984, consisted of two parts:

1. Diagnostic testing of vans to determine current operating efficiency, in conjunction with and using the

personnel and equipment of Car Care Clinics being conducted by the Independent Garage Owners of North Carolina (IGONC), on scheduled Fridays and Saturdays from 10:00 a.m. to 5:00 p.m., specifically:

a. Comprehensive tire pressure and wear inspections.
b. Comprehensive under-the-hood inspections, including air filter, hoses and belts and engine oil and transmission fluid levels.
c. Electronic analyses of engine emissions, through an infra-red probe, for:
   1) % carbon monoxide
   2) Hydrocarbons (parts per million)
   3) % oxygen
   4) % carbon dioxide

Van owners and operators received a copy of all test results, with recommended repairs and maintenance procedures to increase vehicle energy efficiency and reduce operating and maintenance costs. They also received several brochures on energy efficient vehicle driving and maintenance techniques, as follows:

- Car Care Clinic site specific brochure by IGONC.
- "16 Steps to Conserve Energy on N. C. Highways" by the State Energy Division.
- "Routes to Fuel Economy" by ITRE.
- Shell Answer Book #3 - "The Gasoline Mileage Book."
- "How to Find Your Way Under the Hood & Around the Car" by the National Car Care Council.
- "Diesel Fuel (Questions and Answers) for Your Car" by the American Petroleum Institute.

2. A two-hour, indoor Workshop on Vehicle Maintenance and Operation for Vans (training on energy efficient vehicle maintenance and driving techniques), generally on scheduled Saturdays from 1:00 p.m. to 3:00 p.m.: Workshop participants viewed the 30-minute "Featherfoot" film and were tested on their Driving Efficiency Quotient (DEQ). They also reviewed with the Instructor a packet of information they were given on energy and cost saving techniques, and they received a certificate of completion.

The general agenda for the workshops was:

I. Welcome, sign roster, submit registration slips.
II. "Featherfoot" film with DEQ Test.
III. Review of publications on driving habits.
IV. Review of record-keeping.
V. Review of preventive maintenance.
VI. Review of vehicle utilization.
VII. Review of routing and scheduling (trip planning).
VIII. Review of driver training programs.
IX. Review of driver incentive programs.
X. Evaluation of the workshop.

Results

1. 39 agencies participated in the 9 Van Care Clinics.
2. Those 39 agencies accounted for 255 total vans owned – 48% of the "Census of Vans".
3. Those 39 agencies had 124 vans tested – 49% of their combined van fleets.
4. The 124 vans tested represented 23% of the "Census of Vans."
5. The 39 agencies had 116 personnel trained (3 per agency).
6. A summary of the number of recommended repairs and maintenance procedures follows:

Procedures *	# of Vans Tested	% of Vans Tested
None	10	8.1
One	37	29.8
Two	37	29.8
Three	28	22.6
Four	10	8.1
Five	2	1.6
TOTAL	124	100.0

* Out of a possible 7 problems: Tire pressure, tire wear, air filter, hoses and belts, engine oil level, transmission fluid level, electronic engine analysis.

(NOTE: A tenth scheduled Clinic was cancelled because of a hurricane. Seven (7) agencies owning 30 vans were expected at that Clinic. The sometimes low actual versus expected participation during the Program's summer months was attributed to personnel vacations and other schedule conflicts that were not anticipated during the early pre-registration period, in March and April. With two exceptions, all major pre-registered van transportation service providers participated in the Van Care Clinics.)

Results of the Van Care Clinics were reported to the State Energy Division through oral reports, monthly and quarterly progress reports, and a final summary and evaluation report.

Evaluation

The Van Care Clinic Program reached 39 providers of van transportation service throughout the State of North Carolina–predominantly agencies that meet the transportation needs of elderly and disabled (and low-income) persons in rural and small urban areas. Those 39 agencies account for about 30% of all such transportation providers in the State, and for about 40% of all vans used for such purposes.

Of the 124 vans tested, only 10 (8%) "passed" the diagnostic analyses, while 114 (92%) had one or more recommended repairs or maintenance procedures [77 (62%) had two or more and 40 (32%) had three or more.]

The 116 personnel trained represented a broad cross-section of agency personnel: 69 drivers (59%), 38 administrative (33%), 6 maintenance (5%) and 3 other (3%).

Both the van testing and workshop portions of the Van Care Clinics were well received by all participating agency personnel. They left the diagnostic testing knowing what was needed to improve their vans to reduce energy consumption and operating and maintenence costs. They left the workshops knowing proper energy efficient driving and maintenance techniques to reduce energy consumption and operating and maintenance costs. (Repairs and preventive maintenance would further reduce operating costs and significantly reduce overall maintenance costs.)

The participants' total evaluation of the workshop components, on a scale of 1 to 10, was 9. Also, in answer to the question, "Did the Workshop achieve the stated objectives?", 111 of 112 participants answering the question said "yes". (The one "no" ranked all of the workshop components as 10s.) In addition, when provided, participants' comments and suggested topics for other workshops were very contructive.

Every participating agency, and many who were unable to participate, indicated an interest in the Van Care Clinics being continued, and looked forward to the possibility of participating in another series of Clinics throughout the State.

A conservative estimate of energy savings resulting from the 1984 Van Care Clinics, assuming all participants were to implement recommended repairs and maintenance procedures and adhere to recommended energy efficient driving techniques, follows:

	Annual Energy Savings	
	Gallons	BTUs
Implement repairs and procedures (114 of 124 vans with problems)	14,526	1,815,750,000
Adhere to energy efficient driving (69 drivers, only, in workshops)	9,384	1,173,000,000
Total Annual Energy Savings	23,910	2,988,750,000
Per van annual energy savings	127.42	15,927,631
Per driver annual energy savings	136.00	17,000,000
Total per van + per driver savings	263.42	32,927,631

In summary, annual fuel savings resulting from the Clinics were estimated to be over 263 gallons per van driven.

General Application

The techniques employed in the North Carolina 1984 Van Care Clinic Program can be applied to any van fleet of any agency throughout the world to improve transportation for elderly and disabled (and low income) persons through the reduction of operating and maintenance costs. The money saved by reducing operating and maintenance costs could be directed toward providing elderly and disabled persons with more and better transportation.

Attachments 1 and 2 provide summaries of methods to reduce operating costs and maintenance costs, respectively.

Additional information on this Program can be obtained from:

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ATTACHMENT 1

SUMMARY OF METHODS TO REDUCE OPERATING COSTS FOR TRANSPORTATION SERVICE FOR ELDERLY AND DISABLED PERSONS

Research into energy efficient driving techniques in preparation for the North Carolina 1984 Van Care Clinics resulted in the following continuing fuel use awareness and savings elements that will reduce operating costs for elderly and disabled transportation services:

Driving Habits

- 30 second warm-up saves fuel.
- Cold starts/short trips use 20% more fuel.
- Acceleration: apply even pressure (double = 50% more fuel).
- Jackrabbit starts use 2 more mpg.
- Operating speed: 35-45 mph most fuel efficient (33% more fuel used at 70 mph than at 45 mph); 55 mph saves 21% fuel over 70 mph (3 more mpg).
- Anticipate traffic conditions: look ahead 12 seconds, avoid tailgaiting; coast to stop, avoid unnecessary braking; change gears evenly, hold on hill with brake.
- Idling: 30 seconds max. except in traffic, don't gun engine.
- Air conditioner: avoid unneeded use; use on highway driving.

Trip Planning

- Combining trips reduces cold starts and short, fuel-inefficient trips).
- Route selection/scheduling: to minimize stops, maintain fuel-efficient speeds and avoid congestion.
- Vehicle loads: each 100 pounds added uses 3-6% more fuel; fill-up gasoline tank at 1/4 full.
- Travel alternatives: telephone calls; ridesharing.

Vehicle Selection

- Consider miles to be driven, e.g., high mileage.
- Consider short vs. long trip use.
- Consider number and passenger capacities (size) of vehicles.
- Other vehicle features: aerodynamic design; weight (each 500 pounds gained uses 1-5 more mpg); engine size and type, fuel efficiency (gasoline vs. deisel); power options (manual vs. automatic transmission); air conditioner (about 100 pounds extra weigh uses 1-3 more mpg); tires (radials increase mpg 3-7%).

ATTACHMENT 2

SUMMARY OF METHODS TO REDUCE MAINTENANCE COSTS FOR TRANSPORTATION SERVICE FOR ELDERLY AND DISABLED PERSONS

Research into energy efficient maintenance techniques in preparation for the North Carolina 1984 Van Care Clinics resulted in the following continuing fuel use awareness and savings elements that will reduce maintenance costs for elderly and disabled transportation services:

Regular Vehicle Maintenance

Helps prevent breakdowns; increases fuel economy and safety.

- Perform pre-drive inspection:
  Tire inflation to maximum (lose 1% mpg per 2 pounds below).
  Check oil level.
  Check battery posts and cable ends.
  Check electrical system wiring.
  Check fluid levels (radiator, power steering, transmission).
  Check belts and hoses.
  Check lights, horn, mirrors and windshield wipers.
  Check lift equipment (if any).

- Perform preventive maintenance (intervals as in owners manual):
  Change oil and oil filter (multi-viscosity 3-5% more mpg).
  Check air filter (blow out, vacuum, rotate, change).
  Check lubricants (use multi-viscosity, lubricate chassis).
  Check spark plugs (1 worn lose 7% mpg; 2 mis-fire lose 20%).
  Check/set ignition timing, distributor points, cap, rotor.
  Check PCV valve and filter (clean or replace).
  Check fuel filter (clean or replace).
  Check carburetor (clean, adjust, set choke, tighten bolts).
  Check thermostat; pressure test cooling system.
  Check alternator and battery.
  Check brake linings and master cylinder (adjust brakes).
  Check wheel balance, wheel alignment and wheel bearings.
  Check exhaust system for leaks and damage.
  Check fuel lines and pump for leaks.
  Tighten transmission bands if necessary.
  Rotate tires (as directed).
  Diagnostic test (gas analyzer) for emissions and efficiency.

Other Vehicle Maintenance

- Use recommended fuel octane level (monitor use, cost, mpg).
- Tune-ups increase mpg by 4-12% (8-24% if badly neglected).
- Record keeping provides awareness of impending problems, e.g., loss of rate of mpg could signal need for tune-up.
- Hard starting shortens life of battery, starter and fuel pump, and results in more fuel use.

NOTE: Gaining an additional 3 mpg on a van driven 1,000 miles per month translates to a cost savings of $200 annually.

THE CHICAGO TRANSIT AUTHORITY'S HYBRID USER-SIDE SUBSIDY PROGRAM FOR THE DISABLED

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I. INTRODUCTION

This paper describes the Chicago Transit Authority's (CTA) efforts to improve the cost-effectiveness and accountability of its Special Service program, a door-to-door transportation service for persons whose disabilities prevent them from using the standard bus and rail system. In the fall of 1985, the CTA changed the service from an in-house operation to a hybrid user-side subsidy program. The new program, the product of an extensive one-year planning effort, combines laissez-faire elements with a high degree of monitoring and control by the CTA, offering the rider free choice among four competing carriers, while assuring quality.

CTA's previous approach to Special Services was an in-house operation utilizing its own union operators, support staff, fleet of small lift equipped diesel coaches, and separate operating facility. The program began in 1981 in response to federal requirements and reflected a desire for expedient implementation as well as a reliance on available resources and expertise in transportation and maintenance.

This paper reviews the process which CTA followed to implement this major change in service. It describes:

- The CTA program and the service approaches followed in other cities,
- A description of the new hybrid user-side subsidy program,
- The steps followed in selecting private contractors,
- Arbitration between CTA and its transit union on the issue of subcontracting,
- Activities in the transition process, and
- The initial success of the program.

CTA's move to private contracting was stimulated by the desire to provide more service to the disabled population while staying within the authority's limited resources. It was essential to the program designers that the quality of service to which users had become accustomed be maintained. While many of the procedural aspects of the program evolved during the planning process, this commitment to increasing the level of service and sustaining service quality remained the cornerstone of the effort.

II. INITIAL PROGRAM REVIEW

The decision to contract out CTA's Special Services and define the parameters of the new program, was the byproduct of several activities -- a comprehensive review of the operation of the existing service; contacts with other major cities regarding the general scope and philosophy of their own special services and on-site assistance from the program managers of three peer transit systems.

Comprehensive Review of Existing CTA Program - In 1983, the staff commissioned a comprehensive study of the existing service to examine all aspects of the operation and recommend actions which would improve its efficiency and effectiveness. Of particular concern were the dispatching and scheduling procedures. The study also reviewed the feasibility of contracting out the service.

The study identified an extensive list of needed improvements, some involving procedural changes, others requiring major modifications to the dispatching system and computer software. In summary, it concluded:

- Many improvements were needed,
- Estimated demand far exceeded the present supply of CTA service,
- The unit cost of $28.00 per trip was the highest of eleven cities' services, and
- It was feasible and practical to involve the private sector.

These last two conclusions were interrelated as CTA was the only transit system among the eleven surveyed, operating its special services totally in-house; all others relied on private contractors for all or part of the program.

The magnitude of the necessary changes identified the vast difference between the CTA's costs and those of comparable services. The proven success in using the private sector for this type of service, by other Chicago area agencies and across the nation, heightened the CTA's interest in the contracting approach as an alternative to its direct operation. It was felt that CTA could expect to double the service provided with the same budget, if it contracted out the operation.

Review of Contracting Approaches - Once interest had been piqued in the contracting alternative, it was necessary to explore the full range of options available. Contact was made with the transit systems which exemplified the most well-known of these approaches:

- Milwaukee's user-side subsidy program,
- Pittsburgh's multi-agency brokerage program, and
- Philadelphia's paratransit system with centralized scheduling.

Each of these programs represented varying degrees of transit agency control over actual service delivery. They also used private firms in various ways, sometimes in a coordinating and managerial role. Common to all was the involvement of more than one private carrier to transport clients.

On-Site Assistance - To further assist CTA management and staff in scoping out the contracted service, the three program managers from Milwaukee, Pittsburgh and Philadelphia were brought to Chicago as a peer advisory group. This was arranged through UMTA's Public Transportation Network (PTN). By having different programs described together, the staff gained insight into the nuances of the programs, thus developing a clearer understanding of contract special service operations. Another function that the peer group served, was as a "panel of experts" to react to CTA's own preliminary ideas on how its new program should operate. Extensive input from CTA's Advisory Committee on Services for the Disabled and both formal and informal discussions with carriers, were also essential to the development of a workable, acceptable plan.

CTA staff carefully weighed the features of user-side subsidy and brokerage programs, choosing a "hybrid" of the two:

- Rider choice of carrier, fostering competition among the carriers, and
- Centralized monitoring of service delivery by the the transit agency.

In the CTA's opinion, this approach offers the "best of both worlds": The assurances of a prescribed high quality service that are absent in the "laissez-faire" environment of a user-side subsidy program; and, through freedom of choice, the benefits of competition, which riders often aren't provided in contracted services where the transit agency or broker makes the carrier assignment for the user. Thus, the CTA's special service riders are in a "buyers market" and are assured of buying quality service.

III. PROGRAM DESCRIPTION

The program developed is a unique hybrid of the user-side subsidy and brokerage approaches that enables the transit authority to take advantage of market competition and agency control, while remaining within budget limitations. Input solicited from the Authority's Advisory Committee on Service for the Disabled helped shape the program into one which is easy to use and extensively monitored. The uniqueness of Chicago's approach is attributable to a combination of key elements and significant details which together provide more than twice as many trips as the in-house service, with no sacrifice of quality.

Key Elements

Competition is the foundation upon which the program is built. Four carriers compete city-wide with no guaranteed ridership. Because riders are free to choose any of the four, carriers must compete through service quality to attract business.

Cost per trip billing was chosen because of its inherently efficient nature. CTA feels that payment by trip provides carriers with an incentive to group trips which is essentially absent when a cost per hour method of billing is used. To further increase efficiencies, passengers are classified as either ambulatory or non-ambulatory with CTA paying carriers less per trip for ambulatory riders.

Call intake, scheduling and dispatching function performed by carriers allows riders to deal directly with carriers when making trip reservations or altering schedules. By having carriers perform these functions, CTA greatly reduces its role as middle man and allows carriers to develop their own efficient methods of service provision.

CTA's centralized computer, reservation and billing system maintains records for 7,000 certified riders. Carriers must make all trip reservations through the computer, effectively screening out any non-certified users and allowing the Authority to closely monitor the system and establish daily trip limits, should demand exceed supply. Unlike the open-entry user-side subsidy programs in Milwaukee and Pittsburgh, Chicago has limited its entry to four pre-screened carriers, thus allowing the luxury of a centralized data base and providing the CTA with a wealth of statistical information. The Authority supplies each carrier with a printer and two terminals and training in their use.

Service Quality is of utmost importance to the CTA and served as an impetus when making key program decisions. The following are some of the factors designed to keep service quality high.

- CTA established a complaint process whereby riders inform the Authority, not the carriers, of any problems relating to service. All complaints are categorized by carrier, driver and/or vehicle.
- CTA's selection of carriers involved an extensive process (described later) whereby four carriers of the highest caliber were chosen to serve disabled riders.
- Rigorous hiring and training requirements were set for the carrier's drivers. The standards which CTA uses to hire its regular bus drivers were adopted for the program. Additionally, all driver's records were checked with the Secretary of State before certification and are checked on a continuing basis every six months. Each driver, upon successful completion of a five day training course (three days defensive driving and two days sensitivity) is issued a photo I.D. which must be displayed whenever he/she is in service for the Authority. Any of the carrier's office personnel who deal in any way with the riders, must also complete a half day sensitivity training course.
- Carriers must select at least one key employee, vested with decision making power, who will attend monthly advisory committee meetings, as well as any others deemed necessary by the Authority.

- All vehicles to be used in the service are inspected prior to acceptance, and periodically thereafter, and must bear a numbered CTA Special Service sticker in plain view. Vehicle requirements, developed in conjunction with CTA's disabled advisory committee, are based on the City of Chicago's Department on Aging and Disability guidelines and include mandatory state and local inspections. Of the Authority's 42 lift equipped buses, twenty were leased to carriers for a dollar a year (maintenance performed by carriers). All other vehicles are supplied by the carriers.
- Random sample audits of trip tickets are performed daily as a means of insuring accuracy of performance reporting. Full day audits of trip tickets are performed at least once a month. Additionally, CTA plans to conduct phone call audits to further insure reporting accuracy and provide the Authority with a barometer with which to establish the overall level of satisfaction.

Other ingredients which establish the uniqueness of CTA's program include allowing carriers to: mix CTA clients and other clients, refer a rider's trip request to other CTA carriers (if the trip cannot be handled by the chosen carrier) and trading of trips among carriers (with the rider's permission). These measures are included as a way to help carriers improve their efficiency. Currently, CTA does not limit the use of the service. Should demand for trips exceed the the budget driven supply, the Authority will impose a maximum daily program trip limit rather than individual trip quota or trip purpose limits. CTA has contracted with only one carrier to provide its low-demand, late evening service (9 PM-1 AM) as a further cost savings measure. Finally, CTA keeps track of the trips provided by use of a computer generated dispatch ticket instead of selling scrip. Both rider and driver sign a field trip ticket upon completion of the trip. The two tickets are matched, the information provided by the driver is entered in the computer and the hard copies are returned to CTA.

In summary, this unique hybrid program, combining limited entry competition, decentralized scheduling and dispatch, a central reservation and billing system and cost per-trip billing, gives the Chicago Transit Authority maximum control over its contract carriers while allowing carriers free rein in designing their own efficient methods of operation.

Service Parameters: The old system and the new

Until now, this paper has concentrated strictly on the operational planning aspect of this program. How has the program change affected the rider? What day-to-day differences were implemented at the start of the program? Figure I compares the service parameters of the in-house operation with those of the private contracting effort.

The most notable changes are:

- An increase in the number of trips provided (by reducing the unit cost per trip by more than 50 percent),
- Expanded hours of service,
- Reduced lead time for requesting trips, and
- A mixed fleet of Special Service vehicles.

Previously established policies regarding subscription service, in-vehicle ride time, cancellations and no-shows have been retained and formalized.

IV. CONTRACTOR SELECTION PROCESS

The Chicago Transit Board, at the onset, recommended that there be a rigorous carrier selection process. It was the intent of the Board that each carrier be highly qualified and capable of providing the requested service.

CTA staff designed a three step carrier selection process consisting of submission of qualifications, extensive interviews/site inspections and request for price. Each step is described separately in the following discussion and summarized in Figure 2.

Submission of Qualification

CTA concurrently solicited several carriers known to be interested in the project, and advertised a pre-statement of qualifications meeting in local newspapers. All carriers expressing interest were mailed a copy of CTA's draft operating plan and statement of qualifications package.

Twenty carriers, as well as a few members of its advisory committee, attended CTA's pre-qualifications meeting. At the meeting, CTA representatives explained the operating plan and submission of qualifications package. Thirteen firms submitted statements of qualifications which asked for the following:

Ownership of firm,
Type of service operated,
Service areas,
Agency contracts and costs,
Capacity and fleet management capabilities (including vehicle inventory),
Radio equipment and dispatching capabilities,
Proof of insurability to CTA specifications,
Proof of bondability to CTA specifications ($50,000 performance bond),
Major physical facilities,
Willingness to comply with equal employment opportunity and fair employment practices,
Ability and willingness to meet disadvantaged business enterprise goals.

There was little participation from the taxicab industry and, almost immediately, the major Chicago taxicab carrier withdrew upon full comprehension of the insurance requirement. The insurance requirements for the taxicab industry in the City of Chicago are less rigorous than CTA's standards. One taxicab firm remained in the process and submitted a bid. Two additional management firms withdrew shortly after CTA announced that it planned to contract with five carriers to operate citywide. They were willing to compete to procure a contract, but unwilling to compete on a daily basis.

The performance bond requirement of $50,000 was established to insure only financially qualified firms participated. Several firms attending the pre-qualifications meeting chose not to submit qualifications stating that they were unable to meet the bonding requirement.

Interviews

Each carrier that was bondable and insurable to CTA requirements was interviewed for two to three hours. An interdepartmental team from the CTA interviewed carriers to obtain information to evaluate the following:

Dispatching/Scheduling capabilities and procedures,
Mass transportation experience,
Paratransit experience involving disabled persons,
Management background, capabilities and expertise,
Understanding of proposed policies and practices,
Communications equipment - capability and quality,
Maintenance capability, procedures, background and experience,
Ability to maintain leased vehicles,
Dedication to CTA (nondedicated means a mix of riders),
Personnel practices,
Location and number of operational facilities, and
Certainty of capacity; firmness of committment.

At the completion of the interviews, staff had a much better feeling about the number of highly qualified, enthusiastic carriers than they did at the outset of the process. Given that there would be at most six carriers, the problem of finding enough competent carriers changed to one of having to reject excellent candidates and secure reasonable prices.

The interview process was an important two-way exchange of information. CTA provided each carrier with as much information as possible about its current service, travel behavior of its riders, draft operating plan and specifications for its new service. Most interested carriers made site inspections of CTA's operating facility and attended a meeting at the facility to inspect the forty vehicles available for lease.

A number of carriers requested major specification changes to improve potential productivity and exchanged ideas on improving the program. As a result, staff changed some program fundamentals and the nature of competiti to be created. The service area was divided into two zones and three carriers were to be selected to serve each zone from 5 AM - 9 PM (CTA later reversed this change, opting for citywide service), with one carrier providing late evening service from 9 PM to 1 AM. Theoretically, productivity could be increased substantially. Trip trading with the permission of the riders was also added.

One firm completed the interview process but dropped out before submission of prices having been pressured to withdraw by one of the competing candidates.

Request for Price Proposal

The request for price proposal letter (Appendix A) was sent to the remaining ten carriers. It contained specifications for service and vehicles to be operated and established the method of carrier selection: a combination of the low bid method and standard professional service contract. Theoretically, a carrier judged higher in quality could be selected even if their price was higher than carriers ranked lower in quality with lower bid prices.

Carriers were awarded "quality points" based on a ranking of their qualifications. "Price points" were also awarded, with the lowest bids per trip generating the greatest number of price points. Those carriers with the greatest number of combined points were selected. Quality points were tabulated and revealed only upon submission of prices. Carriers could submit a price proposal (cost per trip) for citywide service, in either or both of two zones (three carriers per zone) and as the sole operator for evening service citywide from 9 PM to 1 AM.

Upon opening the price proposal letters, CTA discovered that bids for citywide service were lower than those for zones. It then negotiated with the six carriers with the greatest number of quality points, asking each for a "best and final" price for serving ambulatory and non-ambulatory persons. Ultimately, four carriers were chosen. Each had submitted the lowest prices (citywide) and were the four highest ranked out of ten in terms of quality points assigned. The four carriers and their prices are as follows:

	Ambulatory	Non-Ambulatory	Average	Late Evening
Art's Transportation	$12.50	$14.75	$13.62	
Cook-DuPage Trans.	12.00	14.50	13.25	
Stewart Bus Co.	13.70	13.70	13.70	$13.80
Transit Service Corp.	11.00	15.50	13.25	
Average	$12.30	$14.61	$13.46	

V. ARBITRATION

Service with CTA contract carriers was initially scheduled to start August 18,1985. In mid July, just after the CTA Board authorized the award of contracts to four carriers, Local 241 of the Amalgamated Transit Union filed suit seeking to restrain CTA from providing paratransit services for the disabled with contract carriers. The judge issued an agreed to order directing the parties to arbitrate the issue of subcontracting and directed that an arbitration award be issued no later than August 31, 1985.

Following the judges's ruling, CTA ceased all acivities with its union which related to startup of the contract program. Additionally, plans for printing and distribution of dated materials were halted. Other work necessary for start up continued, including software debugging, computer file updating, information processing, office remodeling, equipment purchases and delivery of supplies.

On August 31, 1985, the Arbitrator issued his award affirming CTA's right to contract and denying the union's grievance.

In the arbitrator's discussion prefacing the award he concludes

> "... the decision to subcontract paratransit services was made following an independent study ... dealt extensively with 'Contracting Options' ... and ... based on the information available the decision was a reasonable management action made in good faith.
>
> ... there is no evidence that subcontracting paratransit services will have any material effect upon the collective bargaining agreement ... 'nor reason to believe the unions bargaining position will be weakened by the subcontracting of this case.'
>
> ... the bargaining unit will not be substantially reduced by subcontracting."

Prior to the paratransit arbitration, CTA had contracted out security and Travel Information Center work, functions previously performed by union employees of Local 241. A grievance was filed over the contracting of security work but was denied by an arbitrator.

In general, it can be stated, that the reasonableness and good documentation of CTA actions were instrumental in securing the arbitrators award. Furthermore, no union employee suffered any decrease in wages or loss of job.

VI. TRANSITION ACTIVITIES

An area of considerable importance to all parties, and one deemed essential to the success of the new program, was that of the transition process. An open exchange of information between riders and staff, and CTA management and operating employees was both necessary and desirable. Toward that end, CTA undertook a number of activities to insure the ease and smoothness of the transition.

- Riders were mailed a newsletter, a mail-back self-classification card and a mail-back survey. The newsletter briefly described the service changes, gave tentative starting dates, listed the chosen carriers and established a hotline number for inquiries about the new service. The self-classification card provided CTA with information about each rider's degree of mobility, vehicular needs, transferability, and mobility aids. It updated CTA's own registration files and allowed staff to classify riders as either ambulatory or non-ambulatory. This information provides carriers with a useful description of their rider's needs and capabilities and establishes the billing rate for their trips. The 28 question survey asked riders for their perception of the current transit Authority operated service, extensiveness of use and demographic information.
- A focus group of subscription riders was convened to discuss strengths and weaknesses of the in-house service and expectations about the contract program. The comments of group participants were used to further guide staff planning and transition activities.
- Since the existing program was saturated, CTA maintained a waiting list for subscription service consisting of approximately 250 names. Calls were attempted to all individuals, most of whom had been on the list for several years. As more trips could be accommodated under the new program, subscription service was established for an additional 70 people at the beginning of the new service.
- "Carrier Choice" ballots were sent to all previous subscription riders as well as those to whom new subscriptions were promised. The card briefly described the new parameters for subscribers and asked them to rank the four carriers or mark a no preference box. Every effort was made to assign each subscriber their first choice carrier while balancing the initial assignments among the four. Each subscription rider was assigned to their first or second choice carrier. Subscribers are free to change carriers every two weeks.
- Subscription riders began using the new service three weeks before the remaining users. This transition period allowed carriers to ease into the service by providing the predictable, set schedule service first. Many questions were answered during this three week period, but more importantly, problems which only actual operation could reveal, were brought to light, allowing a smoother transition for non-subscription riders.

- Car Cards were placed in all Special Service buses. The first card reminded riders to send in their self-classification cards, and reiterated the start dates and hotline phone number established in the newsletter. The second card informed riders of an ensuing delay (brought about by arbitration). The final card told of the new start dates and again asked riders to mail their self-classification cards.
- Just prior to the beginning of the service, a new brochure was mailed which contained detailed information on the use of the new service. Throughout this time, the hotline was available for any and all questions from users.
- Throughout the transition process, CTA staff met with the carriers on a weekly basis to discuss any problems, questions and timetables. This resulted in an exchange of useful information and established a spirit of cooperation.
- Weekly meetings with the data processing department (regarding the centralized monitoring program) and occasional meetings of an inter-departmental task force, helped keep the program on track by highlighting numerous details which may have otherwise been overlooked.

VII. CONCLUSION

CTA's hybrid user-side subsidy program began in the fall of 1985, almost one year following the decision to develop the program. From a cost-effective standpoint the program is highly successful. Competitively negotiated prices vary by carrier and trip type and range from $11.00 for an ambulatory trip to $15.50 for a non-ambulatory trip (less rider's 90 cent fare). In November, 1985 the average cost per trip was $11.96 (includes trips by attendants). The CTA in-house operation averaged more than $28.00 per trip. Even with increased resources for monitoring and administration, the new program will allow CTA to more than double ridership with no increase in its four million dollar budget.

Initial program feedback is generally favorable. Ridership doubled on the second day of full operation by private carriers and complaints have been minimal. Riders appear to enjoy the choice of carriers since the market share captured by the four carriers is not even and continues to shift.

Several activities will allow a thorough evaluation of the success of contract operations.

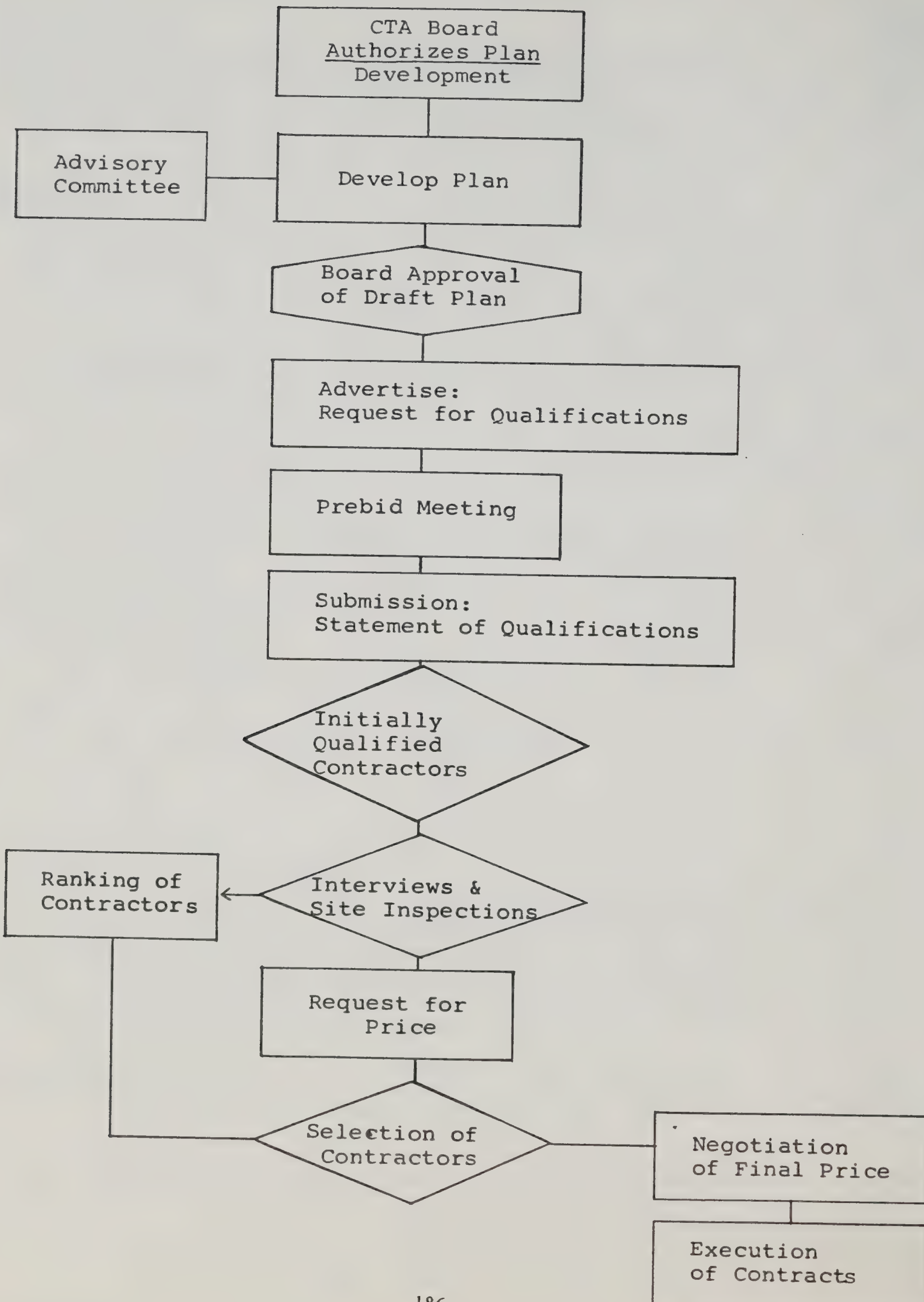
- In the summer of 1985, a mail-back survey about the in-house service was sent to almost 7000 certified users and a large sample of the surveys (35 percent) was returned. Another mail back survey is planned three or four months after startup of the carrier operated service to enable CTA to compare the two programs.
- A focus group interview with eight randomly selected subscription riders, was conducted by a neutral professional interviewer prior to the program start. The emphasis of the focus group interview was on two areas. 1) Answers and concerns from the focus group provided a clearer understanding of the strengths and weaknesses of the in-house service from a rider perspective. 2) The hopes, fears and understanding of the riders, about the new private carrier operated service, suggested what performance by the private carriers, and CTA, was required for the program to be considered successful in the rider's eyes. An interview of these same riders is planned three or four months after startup of the private carrier operated service for a before and after comparison.
- A formalized complaint process for Special Service was created with the changeover from transit authority to private carrier operated service. Complaints provide a meaningful tool to judge service.
- Statistical summaries of performance data provide a wealth of information about the service. Some of the performance indicators include:
  On time performance,
  Average ride time,
  Ridership by carrier and trip type,
  Percentage of trips that are cancelled or no shows,
  Distribution of ridership by hour, day, week and month,
  Trip length, and
  Complaints and commendations.
- An interagency task force has also been created to evaluate the service. It is composed of representatives from the Regional Transportation Authority, PACE Suburban Bus Division, Chicago Area Transportation Study (the metropolitan planning organization), Metropolitan Transportation Association (an association of private carriers), University of Illinois Transportation Center and the Chicago Transit Authority.

Figure 1

Chicago Transit Authority
SERVICE CHARACTERISTICS

ain Feature ervice	Private Carrier Operated Service	Transit Authority Operated Service
ligibility	CTA-Certified Mobility-Limited Residents of the City of Chicago and of CTA/RTA Suburban Demonstration Area	CTA-Certified Mobility-Limited City of Chicago Residents
iders Served	Estimated 1000 per weekday/ 324,000 year@	Approx. 465 per week/ 143,000 year
ours of Service	5 AM - 1 AM every day	6 AM-9:30 PM Monday-Friday 9 AM-5 PM Sat., Sun., Holidays
are	90 cents (exact fare) or monthly pass or token	Same
TA Cost per Trip	$12.30 for ambulatory trip, $14.61 for trip requiring lift-vehicle	$28.00+ (Does not include capital costs or depreciation
estrictions on ider's Trip Purpose	None	None
dvance Notice to eserve Trips	8 hours - 24 hours	24 hours (calls must be placed between 8-8:45 AM previous day
ttendants	One allowed at full fare - Voucher available for transfer to fixed-route service.	One allowed at full fare. Attendants can purchase transfers to fixed-route
aximum Ride Time	1-1/2 hours	1-1/2 hours by informal policy
urcharges	Collected upon 1st and subsequent "no-show" or 3rd and subsequent late cancellation within 30 day period	Same
ubscriptions*	50% of service reserved for subscribers. All current subscription riders are guaranteed a subscription.	Same
olding of ubscription	2 months, indefinitely renewable with proper notice	2 months by informal policy
ehicles	20 Carpenter buses, sedans, vans and other small buses	20 Superior and 20 Carpenter buses
arriers	Four 5 AM to 9 PM and one 9 PM to 1 AM	One
udget	$4,000,000	$4,000,000
ervice Area	City of Chicago and 7 Suburbs	City of Chicago
otice of Trip onfirmation and nd Ride Time	Trip Confirmation when making reservation, pick-up time no less than four hours before trip	Trip Confirmation about 3:30.PM, the day before the trip

Subscription riders are those taking the same trip at least 3 days per week at the same time.
Riders contribute 90 cents toward the cost of the trip.


CTA Board
Authorizes Plan
Development
Advisory
Committee
Develop Plan
Board Approval
of Draft Plan
Advertise:
Request for Qualifications
Prebid Meeting
Submission:
Statement of Qualifications
Initially
Qualified
Contractors
Ranking of
Contractors
Interviews &
Site Inspections
Request for
Price
Selection of
Contractors
Negotiation
of Final Price
Execution
of Contracts

THE IMPACT OF DEDICATED FUNDING ON SPECIAL SERVICE TRANSPORTATION PROGRAMS

THE NEW JERSEY SENIOR CITIZEN AND DISABLED RESIDENT TRANSPORTATION ASSISTANCE ACT

Gerald J. Kane

New Jersey Transit Corporation

I. INTRODUCTION

The growth and development of paratransit and specialized transportation services for elderly and disabled persons have acccelerated dramatically since the 1970's. In New Jersey, a state with a long established record of operating both conventional mass transit and paratransit operations, this trend has been clearly evidenced in the form of legislative enactments, special task forces and funding commitments. In 1980, the Governor's Task Force Report - Coordinating Specialized Transportation Services in New Jersey, provided a total of 19 recommendations for establishing a better coordinated and efficient system for delivering special transportation services: Examples included better defined agency role responsibilities, mandated coordination requirements to qualify for funds, fiscal and program reporting requirements, and the necessity of linking mass transit with paratransit services.[1]

Equally important to the Report's recommendations, however, was the realization of the sizable number of organizations and agencies associated with the provision of paratransit in New Jersey. Government agencies, non-profit organizations, and volunteer groups were at work in each of the state's 21 counties utilizing funds administered by multiple state agencies and their sub-divisions. This administrative-funding structure underscored not only the need to increase coordination and communication, but also made clear that funding was very limited and often restricted to particular clients or programs. During the period in which the need for paratransit gained attention, it was soon discovered how fragmented and disjointed the funding process had become. This situation was particularly felt by service providers in the areas of fleet size and rider eligibility.

Vehicles, in many cases, were acquired in piecemeal fashion and funds used for procurement were often entirely separate from those used for operations. Consequently, operating funds were often used to provide service for clients eligible under agency sponsored programs, thus precluding a large segment of the transportation disadvantaged population from becoming associated with paratransit mobility.[2]

The problem of limited funding and its inherent restrictions was further compounded by the uncertainty of obtaining government funds. Rapid changes in policy and legislation often frustrated efforts of provider agencies to plan services over a multi year period. Consequently, vehicle replacement programs and staging of service growth were not possible.

It is widely recognized that a stable and predictable funding base for publicly sponsored transportation systems (both line haul service and paratransit service) is a critical requirement for improving and expanding service. Ironically, in a state such as New Jersey where major events in paratransit development had occured, most notably the Jitney Service in Atlantic City and Haddonfield Dial-A-Ride in 1972, efforts to meet the demand for an increasing elderly and disabled population were hampered by inadequate funding resources. The 1980 Census counted a total of 1.2 million citizens aged 60 and over in the state, with another 1 million persons identified as having a

disability which prevented them from using public transportation.

It was in this environment that in 1981 New Jersey voters approved a state Constitutional Amendment allowing tax revenues from casino gambling to be used to help fund additional or expanded transportation services for senior citizens and disabled persons. In January, 1984 the state's General Assembly passed enabling legislation (Bill A-3018), and on January 17, 1984 the Governor signed the legislation into law. The Act (P.L. 1983 C. 578) created the Senior Citizen and Disabled Resident Transportation Assistance Program and assigned the responsibility for program administration to the NJ TRANSIT Corporation. Hence, New Jersey became the first state to provide a stable and predictable funding source for transportation services to the state's senior and disabled citizens.

This paper describes the impacts of the casino program as it pertains to the state's 21 counties which receive 75 percent of the funds allocated under the legislation. Since 1984, the program has made funds available to eligible recipients to improve and expand special transportation services. Although the program is still in its infancy, it is possible to describe the major provisions of law and the short term results produced by the new funds.

II. PROGRAM DESCRIPTION

Funds provided through the casino revenue program address the need to improve the accessibility for senior and disabled persons both on fixed route and paratransit modes of service. The primary goals of the program include the following:

- Improve and expand specialized transportation for elderly and disabled person;

- Enhance inter-county and regional travel for such target groups; and

- Develop, improve and maintain the accessibility of New Jersey's mass transportation system.

Key Factors

Program Funding is determined by the amount of tax revenues deposited annually in the Casino Revenue Fund, of which 7.5% is authorized to NJ TRANSIT. Of that amount, 25 percent is allocated directly to NJ TRANSIT for projects which improve mass transit accessibility and the remaining 75 percent is available to counties for paratransit service improvements.

Key to understanding the program's intent is the concept that casino funds are to supplement, not replace, existing funding resources and a maintenance of effort certification is required before funds are approved. Applicants for casino funds must certify that the amount of funds budgeted for transportation prior to the receipt of casino funds is being maintained; the amount is one half of the total dollars

budgeted for the two years prior to the applicant's involvement in the casino program. Any service provider that becomes a recipient of casino funds must provide a maintenance of effort for the two years prior to receiving casino funds.

To date, the program funds have enjoyed vigorous growth and a total of $37.9 million has been appropriated over the first four fiscal years.

TABLE I

Casino Revenue Fund Appropriations
FY '84 - FY '87
(in thousands)

Fiscal Year	Total Amount	NJT Share (25%)	County Share (75%)
1984*	$ 3,000	$ 750,	$ 2,250
1985	10,000	2,250	7,500
1986	11,400	2,860	8,590
1987	13,500	3,375	10,125
Grand Total	$ 37,900	$ 9,230	$28,460

*FY '84 (January, 1984 - June 30, 1984)

Annual allocation's of funds for counties is based on a formula reflective of each county's total population of persons 60 years of age and older. When complete census information on the number of disabled persons residing in each county becomes available, such numbers will also be used in determining the dollar amount. In FY '86 no county received less than $175,000 and no more than $800,000.

Eligible recipients of casino funds are the governing bodies in each county: this body is referred to as the board of chosen freeholders. Other groups may be eligible to recieve casino funds, however, they must first be designated by the freeholders in order to receive funds. In most cases the county office on aging or a county transportation department is responsible for grant management.

In many respects, the progam resembles a county entitlement in that a specific amount of casino revenue funds is made availabe to the counties and NJ TRANSIT on an annual basis. Also, there are no restrictions regarding allowable expenditures for funding special transportation services and counties are free to tailor the service to best suit the needs of persons eligible to receive casino funded service. As discussed later, some counties have selected to build and expand upon the existing service delivery, while other participants have totally reshaped the organization and structure of the provider agency.

The program flexibility is balanced, however, by a thorough application process and, for FY '87 casino funds, the requirement of a transportation plan for coordinating special transportation services. Both elements were included to the program guidelines developed by NJ TRANSIT in consultation with the Special Services Citizens Advisory Committee.

County applications are submitted in the form of a proposal which describes how special transportation services will be improved and expanded with casino funds. Key elements of the proposal include:

- Proposed Service Description
  - budget
  - coordination efforts
  - service performance,

- Description of Public Involvement, and

- Authorizing Resolution.

Applications are reviewed by NJ TRANSIT in conjunction with the advisory committee and approved by the Board of Directors. Each applicant also holds a public hearing to present the proposal and a resolution approving the applications is required from the board of chosen freeholders or the governing body.

Counties are not restricted to providing a certain type of special transportation service; in fact, the casino legislation clearly states that services may include a variety of transportation operations including:

- door to door service,
- feeder service,
- fixed route service,
- local fare subsidy; and
- user side subsidy.

The coordination plan requirement was added to the program guidelines in March, 1985 and required counties to submit plans in addition to the annual application. The requirement was added to encourage a longer range perspective of paratransit planning and operations among county participants. Based on the experience of the initial county applications for funds, it was clear that many agencies were only planning service for one year with little mention of significant changes to the service design over a longer time frame.

A second reason for requesting a plan was to foster increased coordination of transportation services at the county level, since it is here where considerable service overlap is likely to occur. Although coordination and consolidation of service may not automatically solve all problems related to inefficient or unproductive service, the intent was to prompt the investigation of

opportunities to expand service with new funds and reduce the duplication of service which often plagues county systems.

To provide guidance and direction for completing a plan, NJ TRANSIT conducted planning workshops in December, 1985. The workshops were designed to highlight the essential elements of conducting a special service transportation study and the following tasks became the outline for meeting the comprehensive plan requirement:

1. Goals and objectives,

2. Inventory of exisitng service,

3. Estimate transportation need/demand,

4. Evaluate and determine coordination level,

5. Prepare coordinated service plan,

6. Prepare budget-identify funds,

7. Implementation plan, and

8. Annual update process.

It should be mentioned that a fully completed plan was not required by the deadline date in order to receive funds for FY 1987. However, all counties were required to submit work on the first three elements and work schedule for completing the remaining tasks.

Summary

While several programs in the past had partially addressed the mobility needs of elderly and disabled persons, the casino program is intended for all persons in both groups without restriction. Program funds are made available to county governments to provide new and expanded transportation services for the elderly and disabled, and such service must be coordinated. Heretofore, few programs recognized the vast network of service providers and funding sources contributing to special transportation services. Casino funds supplement existing resources and are intended to improve upon existing service by increased funding and service coordination.

To guide the implementation and development of the program, a considerable amount of public involvement is incorporated at both the NJ TRANSIT and county level in the form of citizen advisory committees. In addition, each county applicant must hold a public hearing to discuss the casino application proposal and NJ TRANSIT annually conducts a series of statewide public hearings to gather input on the effects of the program as a whole.

III. PROGRAM DEVELOPMENT

Given the diverse nature of paratransit in general and the variety of

elderly and handicapped transportation programs specifically in New Jersey, the advent of casino funding has affected the development of county programs in several unique ways. Since the law did not specify how the service was to be operated or by whom, each county developed or is developing a program best suited to meet individual county needs. Again, the major requirements for receiving casino funds were that services had to be additional or expanded and that such services must be coordinated. Beyond this, county freeholder's, with input from the local citizen's advisory committee, were responsible for the direction and development of the local program.

Since the beginning of the casino program in 1984 until June 30, 1986 all but two of the states 21 counties have initiated special transportation services using casino revenue funds. The two counties not yet operating service are in the process of developing a system and are expected to begin service prior to the end of 1986. Counties providing service are utilizing the full range of paratransit options, including:

- Demand Response
  - dial-a-ride
  - subscription bus
  - shared ride taxi
- Route Service
  - conventional transit
  - modified fixed route
  - point deviation
  - shuttle service
  - feeder service

Understandably, the challenge of implementing expanded services coupled with the institutional arrangements of providing coordinated service has led to several interesting and complex problems. County agencies accustomed to transporting certain types of clients for limited trip purposes were required to allow all senior and disabled persons to use the service. Medical and nutritional trips, often the only trips carried by many providers, were expanded to include shopping, recreation, education and employment. Such a major departure from existing service caused many counties to form all new systems, many choosing to merge and consolidate operations into one agency.

The changes to county systems have resulted in a variety of paratransit service types as diverse as the number of counties. Common factors having an influence on the direction county systems have followed include:

- Organization and structure of the existing system,
- Land use (geography, land area),
- Population, population density,
- Number and experience of local providers,

- Level of existing funds (non-casino), and
- System size, number of vehicles.

The anticipation of receiving casino funds provided special transporation service agencies with high visibility at the county level and it is interesting to characterize the changes which have occured. The following table illustrates the degree to which systems have changed as a result of the casino funds.

TABLE II

Organizational Changes to County Special Transportation Systems

# of Counties	Type of System Before Casino Program	Degree of Change	Revised System
8	Single county agency or private, nonprofit provider; some coordination of service.	Minor	Expansion of service and increased coordination with local service providers.
2	Single county provider agency serving elderly only; little coordination.	Major	County operated service discontinued; contracted private carrier service coordinated by a county agency.
5	Multiple county providers serving separate client groups; little coordination.	Major	Consolidation of funds and creation of a single transportation provider, operating coordinated service.
6	County provider operating limited service and numerous local providers; little coordination.	Major	Designation of lead county operating agency which also purchases service from local providers.

Of the 21 counties requesting casino funds, more than half experienced major changes to the existing system of service delivery. In two cases, county freeholder's chose to form a completely new operation by terminating the county sponsored service and securing services from private carriers. As the table confirms, however, a frequent response to the casino revenue program was to consolidate existing agencies and funds into a lead coordinator or provider agency. Many counties now had the opportunity to effectuate such a consolidation since coordination of service was a requirement for funding approval. This was especially true for counties previously operating a separate rural transportation service with federal Section 18 funds from social service transportaiton operating with a variety of funds.

Counties not choosing to alter the existing service scheme were primarily those with a long standing, established paratransit operation which enjoyed freeholder support. The experience of these systems plus their sizable vehicle fleets (25 or more) and experienced personnel was sufficient reason to retain the present design. These systems were in the best position to expand and improve service since they did not have to face many of the start up problems which often plague both new systems, and systems operating coordinated service for the first time.

To further characterize the development of the casino program from a statewide prespective, it is helpful to present the amount of casino funds expended since the program's start. In Table III, the program funds approved thus far are compared to funds actually expended by the recipients by budget category.

TABLE III

Amount of Casino Funds Expended
FY'84, 85, 86

BUDGET CATEGORY	AMOUNT EXPENDED	AMOUNT APPROVED
Administration	$ 658,367	$ 2,154,059
Operating	3,142,292	8,754,088
Capital	1,284,091	7,258,562
TOTAL	$5,084,750	$18,166,709

As shown, almost 30 percent of casino revenue funds have been expended by the counties to date. It is important to note that the program did not become operational until late 1984 and the application and review process for the first three fiscal years (FY'84, FY'85, FY'86) was not completed until well into the respective fiscal year. This had the effect of squeezing three years of fiscal appropriations into less than 24 months. This resulted in counties having to plan new services and order vehicles with very short lead time. Further, there is a considerable amount of money budgeted for vehicle acquisition but due

to delays in vehicle delivery and the vehicle procurement process in general, the expenditure of such funds is proceeding slowly. Since the program is based on cost reimbursement, participants may not submit requests for funds until payment is actually made, therefore, the funding expenditures for capital does not truly reflect the amount of casino funds dedicated to purchasing vehicles; this figure may be conservatively adjusted upward by approximately $2 million. Funds remaining unexpended at the close of a fiscal year will not lapse in the succeeding year, however, a county may not carryover an amount greater than its previous year's allocation.

IV. REPORTING REQUIREMENTS

Because casino revenue funds are to complement and not replace existing funding resources for senior and disabled transportation, it was important to establish a trip reporting system from the program's outset. To this end, NJ TRANSIT selected a monthly ridership report which captures key elements related to transportation services and operating data. Included as Attachment I, the Monthly Service Report maintains data on the units of service received each month by funding program or agency providers. Information contained in the report includes the following elements:

- Program or agency sponsor,
- Number of Passengers,
- Client/User Characteristics,
- Mode of Service,
- Hours and Miles of Service, and
- Passenger Trip Purposes.

This information not only supplies NJ TRANSIT with data on the use of casino revenue funds, but it also can be used to evaluate operations and productivity. Also, the service report is the basic document of accountability. Each participating agency in a system can observe the number of eligible clients, eligible trip purposes and client/user characteristics which receive service in a given month.

Initial efforts by the counties to accurately complete the Report produced mixed results. Provider agencies were unaccustomed to reporting such information, and in many cases certain data items were not routinely collected. Since many users of special transportation services qualify for more than one funding program, agencies had to modify the trip intake procedure and assign clients to a particular program.

Over time, most agencies have adopted their information collection procedures to the Service Report format and current reporting is proceeding without major difficulty. This was confirmed by the sumbittal of the fiscal year 1987 casino revenue applications which requested a six month summary of service report data. This information has provided the first genuine review of how well the casino program is functioning, and what impacts have been felt by the users of the service and by county provider agencies.

V. PROGRAM IMPACTS

Initial operation of transportation service with funds from the casino revenue program began in late 1984. Over the past year and a half, efforts to expand services for senior and disabled persons have produced very favorable results. Considering the brief period county agencies and providers have had to assimilate the casino program into their existing operations, there is sufficient evidence to indicate that steady progress is being made toward fulfilling the mandates of the casino legislation.

In the sixth month period from July 1, 1985 to December 31, 1985, 18 of the 21 counties reported carrying a total of more than 1.2 million trips with funds from all program. Approximately 270,000 of these trips were attributed to the casino program, as indicated in table IV.

TABLE IV

TOTAL NUMBER OF TRIPS BY FUNDING SOURCE

FUNDING SOURCES	TOTAL TRIPS	PERCENT
Casino Program	272,301	22%
Title III	377,365	31%
Title XX	140,809	12%
Title XIX	36,541	3%
Section 18	83,117	7%
County	222,778	18%
Other	84,038	7%
TOTAL	1,216,949	100%

The percentage of rides (22%) funded by the program is second only to the Title III Program and is indicative of the considerable impact the casino funds have had on special transportation programs throughout the state. While it may not be entirely accurate to state that all casino program trips are "new" rides, most counties have indicated that a net increase has occured both in the number of individuals requesting service and the number of trips provided by the operating agency.

Table V summarizes the number of casino funded trips by purpose and provides an initial sign of the priority travel needs being met by casino funds.

TABLE V

TOTAL NUMBER OF CASINO FUNDED TRIPS BY PURPOSE

TRIP PURPOSE	TOTAL TRIPS	PERCENT
Medical	75,525	28%
Employment	28,990	11%
Recreation	26,393	10%
Education	6,608	3%
Nutrition	39,458	14%
Shopping	48,149	18%
Other	47,178	17%
TOTAL	272,301	100%

As shown, the medical trips far exceed the number of trips in the other categories. This may be explained by the fact that providers in many counties have traditionally placed a high priority on serving non-emergency medical transportation needs, and this continues to be the dominant category in many areas.

The remaining categories are reasonably balanced with the exception of education, which includes only 3 percent of all trips. This represents a relatively new trip category and many agencies are just beginning to accomodate this request. Also, the majority of paratransit users in the casino program are senior citizens with travel needs other than for educational purposes. As the program matures, it is hoped that county providers will offer expanded service for post secondary educational trips especially for non-elderly, disabled persons.

Overall, the level of service increase and the number of trips provided under the casino program is expected to grow rapidly in the next few years. Much of the difficulty in expanding service quickly, however, is related to the delivery of much needed equipment and the planning of service expansion. Rapid signs of ridership growth will not become evident until agenices are sufficiently equipped to accomodate new riders and gain experience in transporting a variety of clients eligible for service under the casino program.[3]

The challenge for many providers will be to provide a range of services for a very heterogeneous clientle, and to tailor special transportation services to match the needs of persons in the respective counties. In many areas, this represents a significant departure from previous types of operations which served mostly senior citizens and a limited number of non-elderly disabled persons. The acquisition of specialized equipment, and the expansion of services will become increasingly important as the program matures.

Conclusions

Despite the challenges, the outlook for the casino program is very bright. Almost every county is now delivering casino funded service and the opportunity for increased mobility and accessibility is available to both senior citizens and disabled persons. The stability of funding will enable the program to develop and improve even further in view of the following:

1. Casino funds enable county providers to greatly expand the range of transportation services and to offer these services to a larger clientle. Senior and disabled persons are not required to have agency affiliation and trip purposes are not restricted.

2. Funding applicants are required to undertake a transportation plan to investigate the feasibility of coordinating service with other providers. This will at least identify the number of institutions providing special transportation service and may lead to more efficient operations through inter-agency coordination agreements and consolidation of funds.

3. The program endorses a flexible approach to the delivery of service no restrictions are placed on the service modes with providers free to adopt service as appropriate. Counties provide their own service or may choose to acquire service from an independent carrier.

4. Funding expenditures are not limited to certain items but must be approved by NJ TRANSIT in the casino program application.

Because the program is still in its infancy, future ridership figures are difficult to predict. Preliminary indications are that enormous potential for ridership growth exists and counties are only beginning to phase the new funds into their operating systems. Once established, the combination of larger vehicle fleets and the hoped for scale economies through coordinated service will translate into meeting the travel demands of the senior and disabled community.

The role of NJ TRANSIT in administering the program and providing technical assistance to counties for such things as computer hardware and software acquisition for management information and operational improvements, and driver sensitivity training will also have a major impact on the services of the program. Both items are now in the development stage.

The outlook is also positive for continued program growth since funding levels are not hindered by a specific dollar amount or ceiling. New services which utilize casino funds may continue to operate without facing the prospect of being cut back or discontinued as long as casino gaming remains healthy, and the industry continues to enjoy favorable growth. Needless to say, however, the success of

the casino revenue program is strongly dependent on the continuation of existing funding resources. Reductions to these resources, especially at the federal level, will severely compromise the positive impacts resulting from casino funds, since the new funds will be used to maintain service rather than for service expansion.

ATTACHMENT 1

MONTHLY SERVICE REPORT

RECORD OF TRANSPORTATION
SERVICE AND OPERATIONS

C. MONTHLY AGENCY/PROGRAM REPORT

MONTH ____________

PREPARED BY ____________

(21)	(22)	(23) MODE OF SERVICE														(24) PASSENGER TRIP PURPOSES							(25) CLIENT/USER CHARACTERISTICS						
		FIXED ROUTE		MOD. FIXED ROUTE		SUBSCRIP. SERV.		DEMAND-RES.		TAXI		CHART.		VOL.									ELDERLY			HAN-CAP			
SOCIAL SERVICE AGENCY/ PROGRAM	NO. OF PASS.	REV MI	REV HR	REV MI	REV HR	REV MI	REV HR	REV MI	REV HR	REV MI	REV HR	REV MI	REV HR	REV MI	REV HR	MED	EMP	REC	ED	NUT	SHOP	OTH	AMB	SEM AMB	WHL CHR	AMB	SEM AMB	WHL CHR	OTH
TOTAL																													

REFERENCES/NOTES

[1] Coordinating Specialized Transportation Services In Jersey. Governor's Task Force on Transportation Services for Elderly and Handicapped Persons. October, 1979.

[2] This conclusion has been drawn from Ned Einstein's Special Paratransit Service for Elderly and Handicapped Persons-Operational Experience. Final Report. November, 1981. p. 27.

[3] The client group eligible under the casino program is defined as follows:

Senior Citizen - any persons 60 years of age and older.

Disabled Person- "any individual who, by reason of illness, injury, age, congenital malfunction, or other permanent or temporary incapacity or disability, is unable without special facilities or special planning or design to utilize mass transportation facilities and services as effectvely as persons who are not so affected."

PERFORMANCE AUDITING FOR PRODUCTIVE MANAGEMENT OF ELDERLY AND HANDICAPPED PUBLIC TRANSPORTATION SERVICES

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PERFORMANCE AUDITING FOR PRODUCTIVE MANAGEMENT
OF ELDERLY AND HANDICAPPED PUBLIC TRANSPORTATION SERVICES

1. INTRODUCTION

Systematic productivity analysis is increasingly important for the productive management of transportation operations, which must work within increasingly constrained financial resources. Comprehensive evaluation is especially important for specialized services which must strike a politically delicate balance between effective service delivery and necessary cost controls. Performance auditing is one tool managers of elderly and handicapped transit services can use to identify problems and devise appropriate solutions to increase efficiency and effectiveness.

This paper presents a model for the performance audit of such specialized services, based on a program developed by the San Francisco Bay Area Metropolitan Transportation Commission (MTC), the federal and state designated transportation planning agency for that region. First, the intent and purpose of performance auditing are discussed, and the basic elements of the model described. Because the establishment of clear goals and objectives is central to the audit model's purpose and structure, the paper presents guidelines for developing appropriate goals, objectives, and standards for elderly and handicapped transit services. The paper concludes with an overview of special considerations for the successful conduct of the audit process.

2. PERFORMANCE AUDITING FOR TRANSIT SYSTEM EVALUATION

Purpose

MTC has used the performance audit to evaluate the Bay Area's public transit system since 1978. California state legislation passed at that time charged the regional transportation planning agencies such as MTC to

> "designate entities other than itself, a county transportation commission, a transit development board or an operator to make a performance audit of its activities, and those of county transportation commissions and transit development boards located in the area under its jurisdiction, with respect to this chapter and of each operator to whom it allocates funds" (California Public Utilities Code, Section 99246(a)).

The purpose of the program is to assure that the regional transportation planning agency and its transit operators are using state subsidies in a responsible and accountable manner. Although it was established as a legislative requirement, MTC believes that the performance audit should serve a useful purpose--specifically, the audit should be a process that:

- is constructive and useful to the operator being audited;
- identifies achievements as well as areas for improvements;
- initiates an improvement plan the operator seeks to implement;
- is a cooperative rather than a defensive exercise among the auditor, the operator, and the regional planning agency.

Definition and Method

Clearly distinct from a fiscal audit, the performance audit is a systematic review by independent, qualified professionals using formal audit processes to determine whether a transit operator has

- complied with pertinent laws and regulations;
- established goals and objectives;
- developed performance measures and standards;
- achieved desired program results; and
- conducted operations in an efficient and economical manner.

Legislation mandates that the performance audit be conducted every three years.

The actual method for conducting this evaluation, however, has undergone considerable change since the program was established eight years ago. In the past, performance audits had concentrated on select, key issues identified by MTC and the auditor. However, transit operators were dissatisfied with this approach, believing that there were insufficient resources to address the key issues with the depth necessary to make the analysis useful. Currently, the performance audit is structured on a goals and objectives approach. The primary intent is to produce a comprehensive scorecard of transit agency performance, based solely on an assessment of how well the transit operator has achieved its own internal goals and objectives for various system functions, activities, and programs during the period under study.

3. BASIC MODEL: THE GOALS AND OBJECTIVES APPROACH

Advantages

There are several advantages to using the goals and objectives approach over other methods. Transit managers in the Bay Area have long believed that peer group comparisons, a common evaluation method in the industry, were not appropriate for the audit's evaluation of transit operations. Bay Area operators are very diverse in terms of service area, management structure, operating characteristics, and financial environment. It is extremely difficult to define relevant peer groups for anything more than the most cursory, general comparisons. Consequently, inter-operator comparisons for the detailed audit analysis would be unrealistic and misleading. The goals and objectives approach compares the system's changes against internal objectives over time, avoiding cross-system comparisons altogether.

Another major advantage of this approach is that it equitably considers transit system achievements as well as deficiencies. As described below, the program evaluates the system's goals over an entire range of transit functions and programs. It has always been MTC's intention that the performance audit highlight operator achievements, as well as potential areas for improvements. However, the key issues approach previously used tended to down-play areas of admirable performance in order to concentrate on problematic issues even if, on balance, the system was doing relatively well. The evaluation of goals and objectives for all areas gives equal attention to both strengths and weaknesses of the transit system under study.

Audit Model Elements

MTC's general model of performance auditing consists of the following steps:

Phase I: Performance Indicator Evaluation. In this phase, the auditor evaluates a consistent set of performance measures selected by the transit operator, the regional planning agency, the auditor, or some combination of the three. In the case of the California audits, the performance measures are legislatively mandated, and include:

1) operating cost/passenger
2) operating cost/vehicle service hour
3) passengers/vehicle service mile
4) passengers/vehicle service hour
5) vehicle service hours/employee

These measures are not inclusive. In past Bay Area transit audits, these five indicators have been supplemented with additional performance measures. The auditor collects the base data, calculates the performance indicator ratios, and analyzes trends over the audit period. While the Legislation mandates that the audit be conducted triennially, the auditor may wish to analyze a longer trend by including data prior to or immediately following the three year audit period. The group of performance indicators should provide a systemwide picture of changes in cost-efficiency, cost-effectiveness, and service-effectiveness. Section 4 discusses in detail how the audited operator or its governing body may select appropriate indicators for elderly and handicapped services.

Phase II: Pre-Audit Survey

This is perhaps the most crucial phase of the goals and objectives approach, since it sets the foundation for systematically evaluating transit performance. The pre-audit survey is primarily concerned with identifying the appropriate goals and objectives associated with transit functions, activities, or programs. At the outset of the audit, the transit operator and auditor should clearly define an appropriate framework for identifying and evaluating goals and objectives. MTC has suggested that a functional breakdown be used, as outlined in Exhibit 1. However, small specialized transit systems may require a different structure for identifying and categorizing goals and objectives. In any case, the framework should be consistent from audit to audit, allowing for long-term comparisons of performance.

Formal goals and objectives are usually identified through written agency documents, including short and long-term transit plans, internal management papers, agency policies, and reports to the operator's policy board. In areas where there are no formal goals and objectives by which to evaluate performance, the auditor must determine what informal goals and objectives are used in practice. Once identified, informal goals should be discussed with the transit

agency to make certain they accurately reflect agency practice or policy. If the auditor finds no evidence at all of goals, objectives, or standards for a particular function, the absence should be clearly noted.

Phase III: Detailed Audit. The detailed audit is concerned with the actual analysis of performance. Once goals and objectives are identified, the auditor shall review

- the operator's methods to measure goal achievements,
- the reasonableness of the performance standards given past performance and existing constraints, and
- the plans and management actions undertaken to achieve results.

The auditor would assess actual results against expected performance. Ultimately, the detailed audit should present a "scorecard" of functional area or program performance based on the achievement of goals, objectives and standards set for the audit period. Therefore, significant achievements ("high scores"), as well as shortcomings ("low scores") should be highlighted.

Because of its internal focus, the goals and objectives approach is ideally suited to evaluate specialized transit services for the elderly and handicapped. To apply this method for this type of service, particular considerations and guidelines to the basic model are discussed in the next section.

4. APPLICATION OF THE MODEL TO ELDERLY AND HANDICAPPED SERVICES

Setting Appropriate Goals

The crux of the MTC auditing approach is having appropriate goals or standards to measure system performance. This is an especially important consideration for specialized transit systems characterized by a unique clientel and social service agenda that often conflict with financial operating requirements. Furthermore, most elderly and handicapped transit services are quite small and operate within a limited budget. For instance, a sample cross-section of elderly and handicapped services from eight of the nine Bay Area counties had an average fleet size of five vehicles, and an average annual operating budget of $155,700. Small transit system managers working under such circumstances often have not had the time, expertise, or inclination to develop a formal set of goals and objectives to guide operations. Nevertheless, even a simple set of goals or objectives would benefit small system planning and future development, particularly given the uncertainty of the financial resources available to most. Developing such goals is therefore crucial for setting the future direction of the transit system, and evaluating its progress to move in that direction, via the performance audit.

Goal Setting Criteria

It is proposed that three criteria should be used to establish elderly and handicapped transit service objectives:

EXHIBIT 1

METROPOLITAN TRANSPORTATION COMMISSION
FUNCTIONAL AREAS OF A TRANSIT SYSTEM

1. TRANSPORTATION OPERATIONS

   1.1 Service Delivery
   1.2 Safety and Training

2. REVENUE VEHICLE MAINTENANCE

   2.1 Vehicle Effectiveness
   2.2 Maintenance Activity Effectiveness
   2.3 Maintenance Activity Efficiency

3. GENERAL MAINTENANCE

   3.1 Guideway and Station/Shop Maintenance
   3.2 Power Distribution System Maintenance
   3.3 Signal and Vehicle Control System Maintenance
   3.4 Buildings, Grounds, and Equipment Maintenance
   3.5 Non-Revenue Vehicle Maintenance

4. PLANNING AND MARKETING

   4.1 Service Planning and Market Analysis
   4.2 Fare Policy
   4.3 Scheduling
   4.4 Public Relations and Advertising
   4.5 Budgeting and Financial Planning

5. GENERAL ADMINISTRATION

   5.1 Purchasing
   5.2 Inventory Management
   5.3 Risk Management and Insurance
   5.4 Personnel Management and Labor Relations
   5.5 Management Reporting and Administrative Services

6. MANAGEMENT AND ORGANIZATION

   6.1 Organizational Effectiveness
   6.2 Management/Decision-making Process

NOTE: This is a general framework for a "typical" urban transit system. The number and detail of subcategories listed under the six major functions are not relevant for all transit systems, particularly small operations.

- needs of the client
- availability of resources (financial and other)
- coordination with other transportation services.

These criteria are important primarily because of their relationships to one another. Serving "needs of the client" is the major reason for establishing and maintaining specialized transit services to the elderly or handicapped rider. While all public transit systems are concerned with quality of service, considerations such as type of service, service frequency, service area coverage, and ability to pay differ greatly for elderly and handicapped transit operations, designed to meet a need that regular fixed route transit cannot provide.

However, the availability of revenue to cover the costs of providing these services will affect the degree to which specialized transit can meet rider needs. Under a limited budget, a transit manager may have to balance expensive door-to-door service with restricted geographic coverage. Trips to medical facilities may have to take priority over recreational trips if trip frequency is limited. Service expansion may depend largely on the availability of government subsidies to cover capital costs.

Coordinating the specialized service with other available transportation services than becomes very important. For example, if an elderly and handicapped service is restricted within city boundaries, timed transfer arrangements with a regional public transit system increases the travel options of the rider. Rather than investing in a major capital purchase for individual expansions, a group of small, specialized systems may want to consolidate their operations if economies of scale could be achieved.

Consideration of each of these criterion with respect to an individual system's characteristics and operating environment is a important step when developing goals and objectives.

Needs of the client. In setting goals and objectives under this criterion, the transit manager or policy maker would want to consider the following questions:

- o Who are my clients (elderly, handicapped, mix)?
- o How many potential riders in these groups live within my jurisdiction?
- o What are my clients' transportation needs-- medical trips, shopping trips, recreational trips, other?
- o What type of service is most appropriate to meet these needs: door-to-door, group pick-up and drop-off at designated locations?
- o What can my clients pay for these services?
- o What general service standards should be established for schedule adherence, jurisdictional coverage, frequency of service, safety and comfort, vehicle reliability?

Availability of Financial Resources. In setting financial objectives, the transit manager needs to consider the following questions, looking particularly at how the answers may influence issues related to client needs:

- What is my operating budget? Is it likely to expand, decrease or remain stable in the near future?
- What are my available sources of revenue and government subsidy (local, state, federal)?
- Given the future availability of these subsidies, is the system operating under the best of mix of resources?
- What are my capital budgeting needs? Is the system likely to expand or contract based on its performance and client demand for service?
- Which costs are under my direct managerial control, and which are most impacted by external influences?

Coordination with Other Services. This last criterion is important because it may logically bridge conflicting circumstances in the other two areas. Important questions to ask are:

- What are other transit services available to my clients in this jurisdiction? Do they complement or conflict with those I provide?
- Are my services effectively coordinated with complementary transit services, thereby providing the elderly or handicapped client with the most flexible and comprehensive transit service package?

Responses to the above questions can be couched as appropriate goals and objectives for system performance. Exhibit 2 provides examples of possible goals, objectives, and performance standards, which respond to the questions related to the three criteria. As this paper presents a model for performance auditing, it is not appropriate to suggest specific goals for elderly and handicapped services. In fact, it has been argued earlier that these systems are so unique that setting any "standard", universal goals or objectives would be unrealistic.

However, general guidelines for developing appropriate goals and objectives can be provided, as suggested below.

Development Guidelines

Realistic, useful goals, objectives, and performance standards will possess four general characteristics: comprehensiveness, consistency, controllability, and accountability.

Comprehensiveness. Goals, objectives, and standards should cover all important transit system functions, programs, and activities. This does not mean that goals and standards have to be numerous or extremely detailed, especially for small operations.

EXHIBIT 2

EXAMPLES OF GOALS, OBJECTIVES, AND STANDARDS FOR ELDERLY AND HANDICAPPED TRANSIT SERVICE

A. Needs of the Client

1. Goal: Provide efficient transportation services to elderly and handicapped individuals in the suburban area of the City.

   Objective: Provide door-to-door paratransit (van) service to all elderly or handicapped riders living 1/2 mile or more from a wheelchair accessible route of City Transit.

   Standard: Serve x % of travel trips made by elderly and handicapped individuals living within the above defined boundaries.

2. Goal: Provide safe and reliable service.

   Objective: Decrease the number of mechanical breakdowns.

   Standard: Increase vehicle miles between mechanical roadcalls by x % in 1986-87.

B. Availability of Financial Resources

3. Goal: Establish a stable financial environment.

   Objective: Increase the proportion of operating costs funded by local subsidies and fares.

   Standard: No more than x % of total annual operating costs financed by state and federal subsidies by 1990.

C. Coordination with Other Transportation Services

4. Goal: Provide the broadest range of transportation options available to elderly and handicapped riders.

   Objective: Coordinate suburban paratransit services with City Transit fixed route service.

   Standard: At least x timed transfers per day at y transfer points with City Transit wheelchair accessible routes.

The careful selection of broad, general goals and their supporting, more specific objectives is most important to ensure adequate coverage of the range of transit functions. Quantifiable performance standards, on the other hand, should be limited to

- o those measures (often performance indicator ratios) for which accurate data are available; and
- o those measures which illustrate the system's overall cost-efficiency, cost-effectiveness, and service-effectiveness. Care should be taken to avoid developing too many standards, or indicators which cannot be measured or do not provide valuable decision-making information.

The hierarchial relationship of goals, objectives and standards is well known. Appendix A excerpted from MTC's Performance Audit Guide defines these concepts.

Consistency. The goals, objectives and performance standards should be consistent within and across system functions. The entire set of goals and objectives would be assessed for possible conflicts where the successful achievement of one objective hinders achievement of the other.

Controllability. Goals, objectives and standards should be largely under the control of the transit manager or policy board. It is extremely difficult for a transit operator to achieve expected performance levels in areas it cannot at least partially influence.

Accountability. There must be a clear link between particular goals and objectives, and responsible system departments or personnel. Successful achievement of a goal assumes that someone is responsible for it, and possesses the resources needed to carry out its intent.

5. SPECIAL CONSIDERATIONS FOR AUDIT CONDUCT

Section 3 outlined the basic steps of the performance audit. However, several other elements must be considered in order to successfully implement the process.

Roles and Responsibilities of the Audit Participants

A clear understanding of the roles and interactions among the audit participants is extremely important. The general responsibilities of each are discussed below.

The Regional Planning Agency. The MTC model assumes that the regional planning agency serves as the project and contract manager for the audit, relieving the audited operator of the project's administrative duties. However, if the transit operator takes the lead in conducting a periodic audit of its activities, it would assume the following tasks.

As the contract manager, the regional planning agency would prepare the Request for Proposals (RFP); select the auditor, in consultation with the transit operator; manage the contract provisions, including review of all audit deliverables; and provide technical advice during the conduct of the audit. It would also be responsible for the publication and distribution of the final report to appropriate parties. Given the nature of the audit process, there may be instances where the auditor and operator disagree on key points. In such cases, the regional planning agency would serve as liaison between the two, and mediate a resolution to the disagreement.

The Transit Operator. The operator should participate in both auditor selection and development of the audit workscopes to establish a cooperative spirit and understanding early in the process. Once the audit itself is underway, it is the operator's responsibility to provide auditors with adequate interview opportunities and access to information; to ensure the validity of all data provided to the auditor for analysis; and to review and comment on audit products. At the conclusion of the audit, the operator should respond formally to audit findings, conclusions and recommendations (if provided), and take timely action to address identified problems.

The Auditor. The auditor must conduct an objective, thorough evaluation of agency performance, according to audit objectives and professional standards; and produce clear, well-written, accurate, and usable reports. The auditor has the especially important responsibility to consult with all parties (e.g. policy board, management staff, labor unions, etc.) who are potentially affected by published findings, conclusions, or recommendations. This requirement is singled out to emphasize the importance of the auditor having the full set of facts needed to support any finding.

Accuracy of Information

Accurate information is crucial to a successful audit. Erroneous information mars the credibility of conclusions drawn from it; conversely, disagreement over a particular number often overshadows the greater policy issues which are the audit's focus. The auditor is responsible to adequately justify findings and conclusions with solid, clearly documented evidence from reliable sources. However, the transit operator is responsible for providing the auditor with the most accurate information available. At the start of the audit, the operator and auditor should agree on some method whereby the transit manager or other responsible staff confirms in writing the accuracy of data used by the auditors for their analysis.

Recommendations -- Whether and How to Use Them

A broad spectrum of opinion exists regarding the appropriate nature and use of recommendations. Some transit managers believe that recommendations should not be included as part of the audit - the report should simply point out alleged problems. Supporters of this perspective maintain that it is the sole purview of the transit manager to design ways

to address those problems. On the other hand, some managers and many auditors contend that only pointing out major difficulties, which are probably obvious to the agency anyway, is of limited value unless accompanied by suggestions of what to do about them.

Under the goals and objectives approach, it is suggested that the auditor, at a minimum, recommend what should be done for those functional areas where goals, objectives, or standards are either non-existent, ill-defined, inadequate, or in conflict with those of another function or program. Depending on the receptivity of the agency, and the provisions of the project budget, the auditor may go so far as to design specific goals and objectives appropriate to functional area requirements. Conversely, for those managers desiring direct responsibility for goals development, the recommendations would be limited to outlining the level of attention each problem may need (i.e. high, medium, low priority). A possible schedule and criteria for examining goals further could also be proposed.

6. CONCLUSIONS

The performance audit program, as proposed in this paper, is intended to assist transit managers of elderly and handicapped services to

- establish goals, objectives, and performance standards as guidance for future operations;
- systematically evaluate operations against those goals, objectives, and standards; and identify areas for improvements;
- take corrective action to improve deficiencies, based on audit findings.

Improving the efficiency of operations is an on-going effort for any public transit agency. However, resources for public services are declining, especially for those perceived to serve only "special interest" groups, rather than the general population. As subsidies become increasingly scarce and discretionary, transit operators who successfully demonstrate both a legitimate need for their services, and the capacity to fill that need in an efficient and effective manner, have a better chance of securing limited financial assistance. The audit process, regularly implemented, can provide a basis for making that demonstration.

MTC's participation in the federal UMTA Section 16(b)(2) program illustrates the increased scrutiny likely to be given elderly and handicapped services requesting discretionary government subsidy. The UMTA program assists private, non-profit organizations in meeting elderly and handicapped transportation needs by funding 80% of capital costs for projects it approves. The approval process, however, involves fairly critical review by both the region and the state. As the regional planning agency, MTC reviews and prioritizes UMTA 16(b)(2) grant applications from Bay Area organizations, using (among others) the following criteria:

- how well the organization proposes to meet the special transit needs of the elderly and handicapped;

- coordination with other services;

- the applicant's history in carrying out paratransit programs, and the reasonableness of its proposed operating budget;

- the financial stability of the organization and its funding sources.

At the state level, projects endorsed by the region are reviewed by Inter-Agency Committee representing the Department of Transportation, the Department on Aging, the Department of Rehabilitation, and the Department of Developmental Services. Projects approved by that Committee can then be forwarded to the federal government for final funding approval.

If, indeed, the process described above characterizes the future of transit funding for specialized services, transit operators who begin now to establish an on-going strategy of performance evaluation and productivity improvements can expect a clear advantage when competing for limited monies. A performance audit process, based on the goals and objectives model, can be a valuable component of that strategy.

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APPENDIX A
PERFORMANCE AUDITING: GOALS AND OBJECTIVES APPROACH

One of the responsibilities of the performance auditor is to relate actual performance to planned performance. To do so, the auditor must identify the goals and objectives established by the operator, the quantitative and qualitative performance measures used by the operator to measure actual performance, the standards set for performance, and the management actions taken to achieve performance. Five-year Short Range Transit Plans (SRTPs) that are developed by Bay Area transit operators include statements of goals, objectives, performance measures, and standards as established by the transit operator policy boards. The auditor's work should therefore include an analysis of operator's goals and objectives, the reasonableness of standards, the mechanism for reporting, and the extent to which management actions are designed to achieve expected performance and produce results in terms of achieving standards. It should be emphasized that this approach envisions the monitoring of transit operator effectiveness and efficiency in terms of the transit operator's goals and objectives. If they do not exist or are not functioning, the auditor's work would include the assessment of performance without the aid of specified goals, and recommendations that the operator develop goals and objectives and appropriate performance measures in the areas that are most critical to that operator.

In analyzing goals and objectives, the performance auditor should understand how these two elements relate to performance measures, performance standards, and qualitative evaluation criteria.

- Goal - The basic purpose of a transit system is to provide public transit service that supports the economic, social, environmental and transportation needs of the community and the region. Given this basic purpose, transit operators can develop goals which are broad statements indicative of intended results. For example, one might be:

    "to provide a high-quality transit service".

  A transit system may have a number of goals which relate to the basic purpose. Each goal should address the intended results and should serve as a suitable base for developing objectives.

- Objective - An objective describes the manner in which transit operator intends to fulfill a stated goal. In keeping with the concept of increasing specificity as one proceeds down the hierarchy of the planning elements, objectives should set forth specific actions. For example, on objective which might be developed for the stated goal is:

    "to provide dependable service".

  A statement such as this indicates a specific objective which is able to be measured. Being measurable, it provides a means for monitoring and managing performance. There could be a number of objectives developed for any one goal. In developing objectives, one must identify the key factors which have a bearing on goal achievement and express these factors as illustrated above.

Once the objectives have been stated, management can proceed to develop the means by which the monitoring and evaluation process will be accomplished. For purposes of this Guide, the general term "evaluation criteria" is used to identify the components of this evaluation process. These components consist of performance measures, performance standards, and qualitative criteria.

o Performance Measures - Performance measures are quantifiable criteria which will permits an objective measurement and evaluation of performance. For example, pertinent performance measures might be

"number of vehicle miles per in-service mechanical failure": and

"percent of weekday passenger trips delayed over five minutes because of mechanical failure".

Any number of performance measures might be needed to provide the necessary degree of management visibility into performance relative to a given objective. An important consideration is that the management reporting system must be capable of accumulating data for each component of a given measure. The last step in this process is to assign specific values to the measures.

o Performance Standard - Performance standards are the values assigned to each performance measure indicating expected levels of performance. For example, the standard for "number of vehicles miles per in-service mechanical failure" might be set at "12,000" or the "percent of weekday passenger trips delayed over five minutes because of mechanical failure" at "2".

The assigned values must be based on factors peculiar to each transit system or each mode within a system or even to each type of service (e.g., express or regular) depending on the objective and performance measure and the factors that affect the measure.

It is not expected that performance measures and standards would be uniform for all systems in the region. Furthermore, the measures and standards should be developed on the basis of a logic that flows through the process, beginning at the goal level. As conditions change or circumstances warrant, revisions may be necessary at any level in the hierarchy. The important point is that a structured process such as this permits sound management analysis and provides a documented baseline for change.

o Qualitative Criteria - The transit plan elements just described are intended to provide a basis for objective measurement and evaluation. In any management process, there is a place and a need for professional subjective evaluation. Qualitative criteria are the means of accomplishing such subjective evaluations. These criteria consist of fundamental--but highly important and direct--questions concerning performance vis-a-vis stated objectives. The qualitative criteria should address those key aspects which, although not measurable, nonetheless are of sufficient importance to warrant management attention. In the case of the objective "to provide dependable service" a qualitative criterion might involve the public attitude toward the resolution of the problem as measured

subjectively by reports from transportation supervisors or by complaints registered with the transit operator. The formal qualitative criterion might be "severity of impact of the delay on transit patrons" to be evaluated on a subjective basis.

The objective and scope of a performance audit might be established in response to a particular goal or objective, with the performance auditor reviewing the measurement of performance, the reasonableness of standards given past performance and existing constraints, and the plans and management actions undertaken to achieve results. The auditor would then be responsible for assessing the results and recommending improved approaches or specific plans.

URBAN TRANSPORTATION
FOR THE DISABLED IN CANADA
AN ASSESSMENT OF OPERATORS NEEDS

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THE CANADIAN URBAN TRANSIT ASSOCIATION

The Canadian Urban Transit Association (CUTA) is a nationally chartered, voluntary organization committed to a strong, innovative, effective Canadian transit industry. Founded in 1904 as the Canadian Street Railway Association, CUTA has been the national voice of the transit industry for more than 80 years.

CUTA activities include:

- The gathering and distribution of national technical data and operational information on transit.
- Acting as a clearinghouse of transit skills and information.
- The provision of a forum for transit-related issues.
- Support for the development of government programs and policies that will benefit transit.
- The encouragement of transit research and development.
- The communication and promotion of Canadian transit industry developments.

CUTA's members, who represent all regions of Canada, include:

- Transit operators
- Government agencies
- Educational institutions and individual professionals interested in public transit (affiliate members).

Through CUTA and its affiliated provincial chapters, members have access to industry-wide data, statistics and other information helpful in performance reviews, planning, policy development and in running transit systems. CUTA produces a number of regular publications on transit statistics, ridership trends, fares, equipment, labour agreements and other transit issues.

A CHALLENGE TO CUTA

Among the issues raised during a series of seminars and workshops on transportation for the disabled, organized by CUTA, was the lack of an information exchange and service guidelines. There was strong support for a national body to attend to this need and other operator requirements. Accordingly, CUTA approached the operators of transit services for the disabled to seek their views on a proposal to meet their requirements within CUTA. From the response, it was apparent that CUTA, with its national perspective and affiliation with provincial chapters, is the most appropriate agency to address these operators' needs.

A proposal had been made to Transport Canada, Surface, in 1984 for funding to establish a national secretariat for paratransit service operators within CUTA. Transport Canada had suggested that there was a requirement to better identify the needs and issues facing such paratransit operators at the national level and to explore CUTA's role in addressing these needs before a decision was made on the possible funding of a "secretariat". CUTA agreed and endorsed the use of the funds that were provided to conduct a study aimed at establishing the needs of the operators of transit services for the disabled and the role of CUTA in addressing these needs. There was general agreement among CUTA members that transportation for the disabled involved relatively new issues and technologies for the majority of the existing CUTA members that were beyond the challenges of managing conventional transit systems. Since the majority of operators of services for the disabled were not members of CUTA or any other national organization, a comprehensive national analysis of their needs should be undertaken. The study, entitled "Urban Transportation for the Disabled in Canada: An Assessment of Operators' Needs", was carried out during the period September 1985 through March 1986.

The top five organization needs identified by the operators during this study included:

- A strategy for growth
- A need for more system capacity
- A need for more hours of service
- A need for more funding
- Training for management and staff

The top ten management needs identified by the operators during the study included:

- Management strategies to cope with growth and change
- Comparative data from other systems
- Productivity and performance indicators
- Training for management and staff
- Planning guidelines and indicators
- Computer-assisted scheduling
- Demand forecasting techniques
- Lobbying support
- Guidelines for response to advocate groups
- Legislation and trend monitoring

THE NATIONAL MARKET

In 1985, there were approximately 330 operators of special urban transit services for disabled persons in Canada operating more than 1,300 vehicles at an annual cost, excluding capital, of 60 million dollars. Apart from CUTA,

there is no other national association representing these operators, although some 20 percent of these services are either operated or administered by conventional transit systems, many of which are CUTA operating members.

The major significant features of transit service for the disabled in Canada inlcude:

- A rapid implementation of new systems since 1981
- An explosive annual growth rate in ridership averaging 13 percent nationally
- A demand level exceeding the capacity of many systems, particularly those in the larger communities
- A need for organization and management strategies to cope with growth
- A great variety of delivery mechanisms
- A great variation in eligibility criteria by province
- An expressed need for both management and staff training

Eligibility criteria for transit services for the disabled in local communities (with the exception of communities in New Brunswick and Prince Edward Island) reflect provincial funding policies. Such funding policies and any related provincial guidelines for service operators are based on current provincial goals and objectives with respect to both social and transportation issues that are unique to each province. At present, there are three major categories of persons eligible for special transit services. These include:

- The Elderly and the Disabled, i.e. 12-15% of the population eligible (e.g. communities in Alberta, Saskatchewan and those without conventional transit service in British Columbia).
- The Disabled, i.e. 2-3% of the population unable to use conventional transit (e.g. communities in Quebec, the Yukon, Newfoundland, and in British Columbia).
- The Physically Disabled, i.e. 1-2% of the population unable to board conventional transit (e.g. communities in Ontario, Manitoba and Nova Scotia).

SERVICE OPTIONS

A great variety of transit service options for the disabled exist throughout Canada. As a category, most of the elderly and the ambulatory disabled are able to use conventional transit services. The operators of conventional transit services have undertaken significant modifications in an effort to make the conventional transit services as accessible as possible. Some new rapid transit systems such as the ALRT system in Vancouver have been made accessible to most of the disabled. Accessibility to other conventional transit systems has generally not been a major issue because of the high-quality parallel systems and services.

For those of the ambulatory disabled who are unable to use conventional transit services but who do not require a lift-equipped vehicle, taxis are often used. In the Province of Quebec, for example, eligibility committees are established that help to channel disabled persons, in accordance with their degree of disability, toward the means of transport best suited to their needs. This often results in the use of taxis. In the cities of Hamilton, Calgary, and Edmonton, for example, taxis are used very effectively. In Edmonton, taxi companies are also operating van services for the disabled.

In British Columbia, for those communities that do not have conventional transit services, a form of paratransit service is provided. This paratransit service utilizes small, lift-equipped buses to serve all persons in the community. Similar systems have been utilized successfully in other provinces.

For the non-ambulatory disabled, lift-equipped bus systems are operating in most urban communities of 25,000 or more persons. Many provinces have programs to provide similar services in small urban and rural communities, particularly in those without conventional transit service.

The following table shows an estimate of the percent of the urban population of Canada that has transit service for the disabled for several categories of community size:

Under 5,000 persons	15%
5,000 to 25,000 persons	25%
25,000 to 100,000 persons	60%
100,000 to 500,000 persons	92%
Over 500,000 persons	82%
Total for Canada	73%

CURRENT EXPENDITURES IN CANADA

The estimated total annual operating cost (including administration, but not including capital) for the 330 special transit services for the disabled in Canada, based on a fiscal year-end of March 31, 1985, is 60 million dollars. The source of these funds was mainly municipal and provincial grants and subsidies. The proportion of revenues from user fares has been declining from a high of about 15 percent in 1979 to 11 percent in 1981, and accounted for less than 8 percent in 1985. The distribution of funding for operations only (not including capital items) is as follows:

Provincial funding	$31,000,000	(52%)
Municipal funding	23,000,000	(38%)
Fares	4,500,000	(8%)
Other sources	1,500,000	(2%)
Total	$60,000,000	(100%)

"Other" sources of revenue include the estimated value of donated services and funds. Fare revenues are based on an estimated total ridership of 4.5 million trips at an average fare of $1.00.

It is difficult to relate actual capital expenditures to operating costs because of substantial differences in provision of, an accounting for, funding. For example, for communities in British Columbia, the province owns the vehicles and leases them to the operators. In most other communities, capital expenditures are made on an ad-hoc basis and amortization is not provided for. On the basis that capital costs are normally about 12 percent of total costs, the average equivalent annual capital expenditures related to the above operating costs are estimated to be 7 million dollars. The major sources of such capital funding are as follows:

Federal funding	$ 500,000	(7%)
Provincial funding	5,200,000	(75%)
Municipal funding	1,300,000	(18%)
Total	$ 7,000,000	(100%)

Coordinated Social Services Transportation

Making it Work in Napa, California

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Introduction

Throughout the specialized transportation community, there has been much emphasis placed on the need to initiate programs which would utilize scarce resources in a more effective way to serve the needs of the many elderly and handicapped persons who depend on dial-a-ride services for transportation to social services programs and general community resource centers such as grocery stores and medical facilities.

In many cases, each separate program, whether it be a meal site, sheltered workshop, or a senior center, has operated its own vehicle, sometimes for only two or three hours a day. These programs began for the most part in the 60's and early 70's, aided in many cases by government funding for vehicles as well as for program services.

In the early 1980's, this trend began to slow, and many agencies found themselves in a funding crisis. Money was drying up for basic services. Providing in-house transportation became more expensive, and, in many cases, was the first support service to be cut when funds became tighter. New interest grew in ways to stretch funds yet preserve the quality of service to a unique population group.

In California, a motivating piece of legislation was passed in 1979 which gave limited incentives to those agencies which were willing to assume the role of prime mover for coordination and and consolidation of social services transportation. AB 120, the Social Services Transportation Act, encouraged the formation of Consolidated Transportation Services Agencies (CTSAs), mandated the formation of action plans for coordination by each county, and provided that CTSAs could be eligible for direct state Transportation Development Act (TDA) funds for specialized services.

In some areas of California, this legislation was used as the catalyst for developing ambitious projects to seriously attack the problems facing agencies trying to meet an ever-growing need with ever-shrinking resources. Napa County was one area where the AB 120 Action Plan was put into effect over a three-year period.

Developing the Action Plan

A consortium of concerned agencies, transportation providers, client representative groups, and local officials developed the action plan, and recommended that the County of Napa become the designated CTSA, with the Volunteer Center of Napa acting as the operation/implementation arm of the CTSA. The Volunteer Center was already operating three distinct dial-a-ride programs under one umbrella: a volunteer transportation program, a van service within the greater Napa urbanized area, and another van service in the rural areas of the County. The programs were not tied to any particular social service program, but many agencies of the county utilized these programs for client transportation. Thus the Volunteer Center was seen as the most logical focal point for

further coordination efforts within Napa County.

Defining Coordination

One of the biggest problems facing any effort toward coordination is overcoming the reluctance of potential participants. For many agencies, the fear exists that if they participate in any 'coordinated' effort, it will necessarily mean a loss of control, reduction in quality of service, and a dehumanizing of client relationships. Often an agency will feel that no one can understand the unique needs of their particular client in the same way that they can. Thus, the approach to defining coordination must be sensitive to these fears, and able to encompass the many concerns that potential participants might have.

In Napa, coordination was defined in a very broad way, which provided opportunities for participation on many levels. The definition included options for:

a. Participation in a volunteer driver pool
b. Participation in a central information/ referral pool
c. Participation in training programs for drivers, staff, and clients sponsored by the CTSA
d. Opportunities to purchase service on existing CTSA vehicles
e. Opportunities to time share their vehicles with other agencies through the CTSA
f. Opportunities for the CTSA to operate their vehicles on behalf of their clients
g. Fare subsidy arrangements
h. Legislative support
i. "one time only" arrangements for special trips

In this way, there were varying degrees to which any agency could benefit from participating in the CTSA's program. The approach was to offer whatever resources would best meet a particular agency's client needs, taking into account any institutional problems, funding constraints, and logistical impediments. Any agency could define its own level of participation, and derive immediate benefit from cooperation with the CTSA.

First Steps

Following adoption of the local Action Plan and designation of the CTSA. the Volunteer Center began examining opportunities for coordination which would have an immediate effect on efficiency and economy. Two dispatch centers were combined into a central office from which all Volunteer Center transportation services could be directed. A single radio base station kept dispatchers in touch with all CTSA vehicles both in Napa and in the rural areas. The Volunteer Center began compiling a directory of transportation resources throughout the county, and served as the Transit Information Center.

In the meantime, the County, as the planning and administrative arm of the CTSA, consolidated several resources for operations support of the services of the Volunteer Center. The County provided a consolidated application for state funds from the County, and the smaller cities of St Helena and Calistoga to provide operating funds for the rural service, obtained a van from the City for use within Napa, and supplemented CTSA funds with other local transit funds to subsidize operations for the Napa van and Volunteer transportation programs.

These internal efforts were important to demonstrate to potential participants that coordination would be a principle that would guide the internal as well as the external activities of the CTSA.

During this period, service to other agencies by the CTSA was confined largely to purchase of service agreements on existing CTSA vehicles, and was constrained by the shortage of vehicles and time slots available for these types of arrangements.

Building a Support Base

The original consortium which helped develop the local Action Plan, and which recommended the CTSA designation evolved into a body which continued to be involved in local transportation issues. It became a Paratransit Coordinating Council (PCC) and acted as an advisory group to the Board of Supervisors on transit issues.Most agencies who could benefit from participation in the CTSA were members of the PCC and were therefore instrumental in monitoring its progress.

The PCC was involved in the grant review process, and made recommendations to the regional transit planning agency for the granting of vehicles for specialized transportation through the Federal capital grant program available to non-profit agencies. The PCC would not recommend a grant for any agency which could not demonstrate a willingness to coordinate. After the formation of the CTSA, the PCC adopted a policy whereby all grants for vehicles from this source would have to be initiated by the CTSA.

Through the PCC, the value of coordination was developed and supported, and each agency had an opportunity to contribute to the directions that would be taken by the CTSA. Now it would be up to the CTSA to prove that these concepts could work.

Major Steps

The first agency to turn to the CTSA for major assistance in service provision was the local senior meal project. Cutbacks in funding had forced the congregate meals program to examine cost-saving measures, one of which was to discontinue direct operation of the van used to transport seniors to meal sites. The CTSA offered to operate the van on behalf of the program on a per-trip basis. The Dining Club program was thereby relieved of the administrative burden of the transportation, and was still able to provide service to seniors who needed a ride to the dining site.

Although the sponsoring agency maintained ownership of the vehicle, the CTSA operated the vehicle and controlled the administration of the service. The CTSA maintained the same driver and same schedule, and most of the seniors who used the service did not know that a change had occurred.

During this same time, the local Agency on Aging sponsored a fare subsidy program for seniors which was good for a half-fare trip on any CTSA service. This universal subsidy provided additional incentives for service improvements.

As a result of a county-wide vehicle inventory, the CTSA was able to identify agencies who operated vehicles in a very specific way. The inventory identified days and hours of operation, number of clients served, vehicle features such as seating capacity and accessibility, and administrative issues such as how many drivers were used and how transportation funds were budgeted. The inventory allowed an opportunity to examine efficiency and identify gaps in service that existed as a result of underutilization of vehicles.

Utilizing this inventory, the CTSA began to establish a list of unmet needs from other agencies, and to try to match those needs with existing underutilized resources. Innovative approaches were developed to meet individual needs. Among the accomplishments developed were:

1. <u>Linking of service from the State Hospital to an independent living skills program for State Hospital residents.</u>

   The independent living skills program had been using their van to transport some residents of the State Hospital to the program site. The Hospital was approached by the CTSA to meet with this program to see if this responsibility could be transferred from the skills program to the hospital, since the hospital had a more expansive vehicle fleet. No one had ever investigated this possibility, and the transfer of responsibility took place with no cost to the indipendent living skills program. Their van gained vacant seat space and time that could be used to transport other enrollees who could not be served before.

2. <u>Time sharing of unused capacity on agency vehicle</u>.

   When the CTSA took over the Dining Club operation, the vehicle was only used between the hours of 10:00 am and 2:00 pm. A sheltered workshop program needed transportation for enrolless who worked from 8:00 am until 4:00 pm. The dining club vehicle

was made available to these clients during these hours at an hourly rate which covered operating costs, thus increasing the efficiency of the vehicle and providing service to 15 clients who had been without transportation to their worksite.

3. Several local recreation groups entered into agreements for transportation of seniors to Bingo games. The recreation groups paid the drivers, and fares paid for the marginal operating costs of the vehicles, which were used during their unscheduled time on weekends for this service.

4. A driver training program was provided to local agencies. Participants included drivers from several non-profit agencies as well as local taxi companies.

5. The CTSA applied for and was granted vendor status from the state Department of Developmental Disabilities. This allowed local programs to have an option to continue providing their own transportation for their developmentally disabled clients, or to have the CTSA provide it. Through the vendorization, both major programs opted to turn their vehicles over to the CTSA and get out of the transportation portion of their service program. For the two programs, transportation had been a money-losing proposition. For the CTSA, since transportation was its only concern, the subsidies provided through the vendorization were sufficient to cover all related costs. As a result of this consolidation, four additional vehicles were added to the CTSA fleet.

6. Using the vehicle acquired as a result of the vendorization contract, unused time and seating was contracted to a local senior outreach program for transportation of persons to a day services program.

Throughout this evolution, constant contact was maintained with each participating agency. Their concern for service quality was incorporated into the proposals for service provision. A variety of payment options was developed which fit into each participants funding constraints, institutional needs, and client concerns. Each step in the process provided an example for other agencies, and one success built upon previous successes.

Problems

One attempt that was made to act as a broker/operator of one agency's vehicles on behalf of another was abandoned when the insurance agency providing the coverage for the vehicle refused to accept a second party's involvement(the CTSA's) as an operator. A local church had offered its van for the provision of transportation to seniors to the day services program, and was willing to allow CTSA drivers to drive for the time periods necessary to transport participants to and from the site.

Even though CTSA drivers were trained, and the CTSA was willing to cross-insure the church, the unwillingness of the church's insurer to allow such operation halted progress.

Another attempt to utilize the vans of a local Head Start project for supplemental transportation for various agency client needs had to be abandoned when time perameters could not be defined on a regular schedule.

These institutional barriers to coordination were real, and not a result of the unwillingness of the participants to coordinate. In the last two years, insurance has become even more of an issue for all specialized service providers, and in many cases has made the coordination of services even more difficult.In the case of the Head Start vehicles, problems resulting from the need for unexpected or sporadic access to vehicles which could not be anticipated in advance prohibited making these vehicles available for regular dependable uses outside of the program, even though the Head Start administration was willing to provide vehicles when it could. In this case, because the CTSA and Head Start insured their vehicles with the same insurance company, the barriers did not come from insurance restrictions.

Financial Strategies

Since primary funding for the administration and operation of the CTSA was in place, any supplemental service could be added without additional overhead to a certain point. Operating costs associated with additional hours, miles, or vehicles could be easily added under the Central umbrella. Because the CTSA was involved with no other service delivery except for transportation, it could devote the necessary time to this end of the service delivery system without additional administrative costs. However, at some point, additional staff would need to be added to handle the burdens of multiple funding sources and a variety of reporting requirements. Thus the CTSA built in a percentage of administrative costs to supplement the system in place.
In every case, the CTSA was able to offer the same or higher levels of service at reduced costs to the agency in need of the service.

Multiple funding reduced overall fixed costs by spreading them among a variety of sources. For example, insurance costs could be prorated among the agencies who time shared a vehicle, since these costs were generally based upon the vehicle's age, operating radius, and value, not on the number of hours operated or number of passengers carried.

In addition, funding from other sources could count as local match against the CTSA primary operating budget, which required a 10% ratio of match to costs. In the first year of coordinated service, the CTSA raised its overall local match to 17% through local service option contracts.

Depending upon the resources, needs, institutional structure, and availability of CTSA resources, each agency contract was designed to maximize benefits and reduce overall costs. However, from the very beginning, no agency was able to obtain direct service (rides for their clients) without some kind of contribution, whether it be cash, volunteer drivers,or vehicles. Many agencies recruited their own volunteer drivers, sent them to the CTSA to be trained, and then added these people to the pool of volunteer drivers made available for generalized service provision once the sponsoring agency's client needs were satisfied. Some contracts offered different rates, depending upon whether or not the driver for the particular service would be agency-provided or CTSA-provided. An hourly rate was established for one-time only trips (such as Convalescent Home outings or the Special Olympics), and a mileage rate was established for longer or ongoing service contracts. Some agencies, such as the recreation groups who sponsored trips to bingo games, collected fares from the passengers which they then used to offset the contract costs.

In other words, the CTSA developed a variety of cost allocation methods which could be applied depending upon the particular situation. This further encouraged agencies to participate.

Indirect contributions to coordination

The provision of support services by local governments was an essential but largely hidden part of the coordination process. As new vehicles came into the CTSA fleet, they were added to the maintenance program conducted by the local school district at the school bus maintenance site. Vehicles were stored at the City's bus yard, and in the rural areas, at the corporation yards of the cities of Calistoga and St. Helena. The County allowed access to its radio communications channels, and maintained the 2-way radios. This helped keep costs down and allowed for good control over capital.

Conclusions

In Napa County, California, a small, largely rural area in the northeastern fringe of the San Francisco Bay Area, coordination of transportation services has largely been successful due to a number of factors that could apply almost anywhere.

First, the enabling legislation, while not essential for coordination to occur, did provide a catalyst for developing local approaches.

Second, everyone who had a stake in the effort, from defining coordination to contributing financially, was involved not only at the beginning of the process, but continuously.

Third, agency biases, fears, needs, problems, and financial situations were taken seriously during the assessment process.

Fourth, everyone who wanted to benefit was expected to contribute. Benefits gained were commesurate with what was contributed.

Fifth, the lead agency was committed to the follow through that was developed in the beginning. CTSA staff were able and willing to do the difficult job of assessment, problem solving, and financial calculations which were necessary to make each facet of the effort workable. Staff displayed the enthusiasm needed to convince participants that there might be a solution to their problems if they were willing to take a small chance in the beginning. CTSA staff could also monitor those efforts undertaken to be sure that service quality remained high and agencies were satisfied with the service their clients were receiving.

And, finally, perhaps most importantly, baseline funding was in place. Without the funding, there would not have been the staff who could devote such a concerted effort toward the goal of coordination.

Because the needs, problems, and resources of the elderly and handicapped who need our services are so diverse, we must be willing to step outside of the traditional ways that transportation service is delivered, and develop new and creative approaches. The willingness to try is the very first step.

HOW TO CREATE A STATEWIDE ORGANIZATION FOR RURAL AND SPECIALIZED TRANSPORTATION PROVIDERS

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HOW TO CREATE A STATEWIDE ORGANIZATION FOR RURAL AND SPECIALIZED TRANSPORTATION PROVIDERS

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STATE ASSOCIATIONS

Associations exist for the purposes of information sharing, legislative advocacy, and sharing of resources. Associations for urban fixed route transit operators have been active for over 100 years in the U.S. These associations exist at the State level as well as nation-wide. Small and rural operators found that issues addressed by these associations often were quite different than issues facing small operators.

Until recently, efforts by small and rural transportation providers to organize have been fragmented and unsuccessful. Nevertheless, there has been a growing awareness of the value in developing formal networks of such providers. By applying the organizational techniques and political sensitivity used by the founders of the California Association for Coordinated Transportation (CalACT), other rural and specialized transportation providers can develop viable, effective statewide associations.

THE CALIFORNIA EXPERIENCE

1. Composition of the Board of Directors

California is a diverse state. The population centers of Los Angeles Basin and the San Francisco Bay Area are urbanized and congested. The Central Valley contains large agribusinesses and ranches. The mountain areas to the East are sparsely populated and rely on recreational activities for financial support.

In addition to the population diversity, there exists a political division between the Northern and Southern areas. It is commonly felt in the North that the residents of the Southern part of the state drain the resources of the North; it is commonly felt in the South that the residents of the Northern part of the State have undue political influence in the State Legislature.

The organizers of CalACT realized very early in the development of the association that the real or perceived differences between the

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population centers of the North and South and the differences between those centers and the rural areas should be recognized in the composition of the Board of Directors. The elected Board is based in part on representation by population area: 5 representatives are elected by members in the South; 2 representatives are elected by members in the San Francisco area; and, 1 representative each is elected by members in the far North area, the Northern Valley area, and the Central Valley area respectively. Five additional members are elected at-large by all members in the State. This method of representative government does consider all factors of diversity in the State.

2. Legislative Advocacy

Credibility of State association is measured by its impact on policy that directly affects members. The organizers of CalACT realized that without total member consensus on legislative issues credibility in the legislature would be seriously questioned. A policy has been developed by the Board of Directors that the membership will be actively involved in the development of a legislative agenda and that the Board will not initiate legislation which is not a part of that agenda. The Board has also established a Legislative Committee that is representative of large and small operators, urban and rural members, and members of Southern and Northern California. The Board of Directors will endorse only that legislation that has consensus support of all the members of the Legislative Committee.

3. Relations with State Agencies

Establishing Credibility with State agencies is of equal importance as establishing credibility with the State Legislature. The organizers of CalACT identified key staff of the State Department of Transportation and invited their participation in the association's development. This activity must occur during the early stages of development in order to recognize areas of common concern and possibly address those areas through organizational change. CalACT has determined that a cooperate relation with State agencies is an invaluable asset even when the association and the State agency are in dispute over an issue.

4. The First Workshop

The first workshop of the association establishes credibility with peers and potential members. The organizers of CalACT were sensitive to all the factors that would assure success of a workshop:

- topics were current and speakers were dynamic;
- the workshop site was attractive and convenient;
- the accomodations were of very high quality, yet inexpensive; and,
- the registration fee was modest.

CalACT organizers actually delayed the first workshop by four months to assure that all the above factors were present.

SUMMARY

Transportation operators who are in the process of establishing State organizations should insure that:

- all segments of specialized transportation are represented. CalACT addressed this issue by providing for open membership.
- the governing board reflect the geographical diversity of the State. CalACT addressed this issue by providing both at-large and regional representation. CalACT also established an Executive Committee of the governing board that has designated representation from rural and urban areas.
- legislative activity be supported by all members. CalACT has developed policies guarantying that no member will be adversely impacted by legislation supported by CalACT.
- a good and cooperative relation be nurtured with the state agency responsible for transportation; and,
- the first workshop sponsored by the association be timely focused, pertinent, and as professional as possible. CalACT found that organizational credibility is a function of workshop quality.

By addressing these issues and establishing an environment of flexibility, specialized transportation operators, particularly those in rural areas, can develop formal associations for mutual benefit.

PROGRAM FOR TRANSPORTATION OF THE MOBILITY DISADVANTAGED IN RURAL MANITOBA

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PROGRAM FOR TRANSPORTATION OF THE MOBILITY DISADVANTAGED IN RURAL MANITOBA

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The Program for the Transportation of the Mobility Disadvantaged in Rural Manitoba was initiated in 1981 to replace a system of ad hoc grants. Some background on Manitoba may make it easier to understand our program.

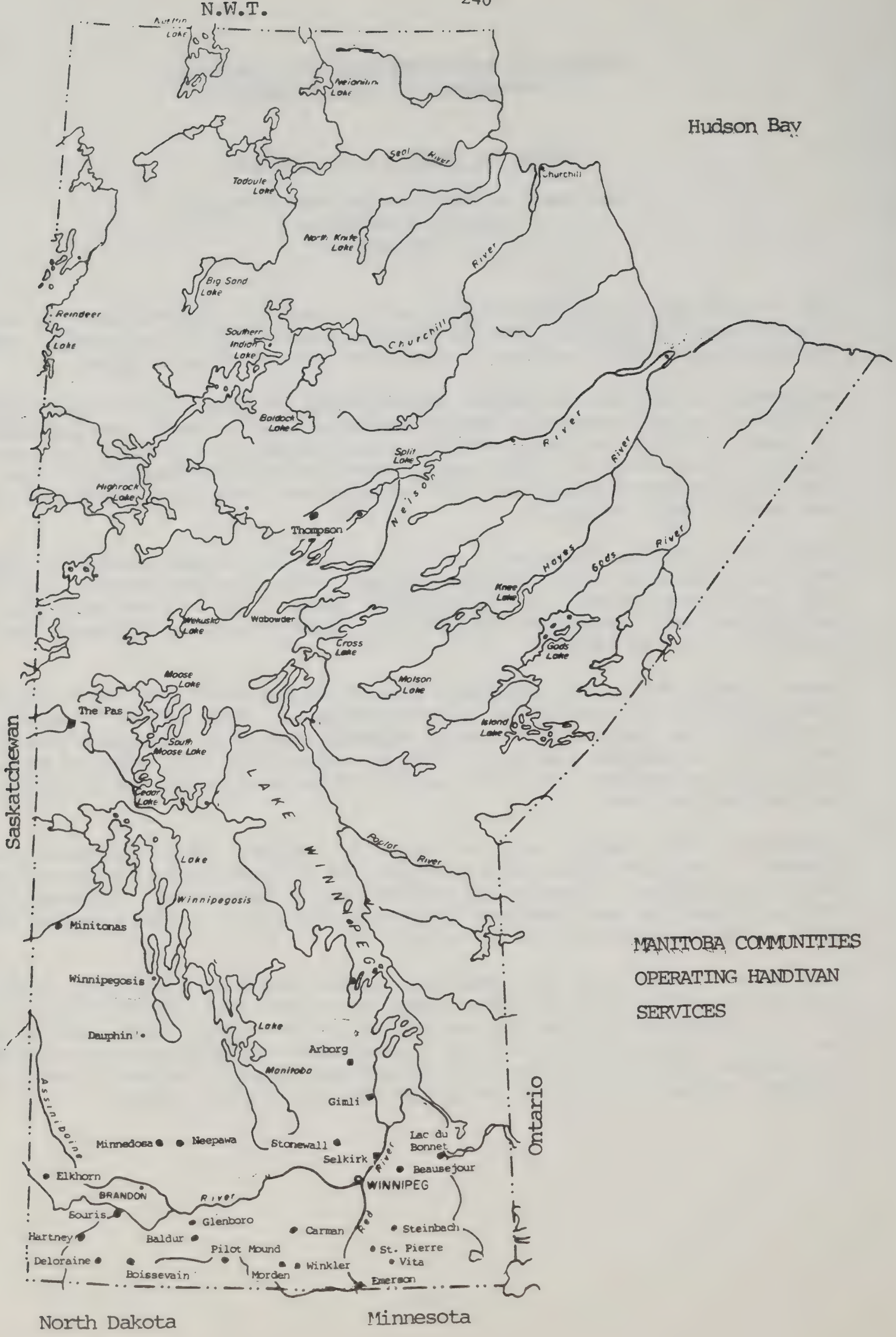
Manitoba is a province of 251,000 square miles, of which 173,000 square miles is located in the Precambrian Shield and Hudson Bay Lowlands. Our population is about 1,070,000 of which 603,000 are in Winnipeg. Brandon, our second largest city is home to 36,000 people. Most of the remaining 431,000 live in the 78,000 square miles of southern Manitoba and are mainly associated with Manitoba's farming economy.

The Program for the Transportation of the Mobility Disadvantaged in Rural Manitoba deals with the communities outside of Winnipeg and Brandon. For the most part these communities are generally small. The smallest community in our program has a population of 344. Our largest community, Thompson, has a population of about 15,000.

About 12.4% of Manitoba's population is over the age of 65. In rural Manitoba the proportion of seniors is slightly higher. Most of the communities involved in our program have a high proportion of their population over the age of 65. In Baldur, 63% are in this age group. The high number of seniors is due to the fact that many have turned the family farm over to the children and retired into town.

Communities like Baldur are too small to support public transportation systems. Very few have a taxi service. As a result, people provide their own transportation. However, as seniors become more frail, transportation options become limited. Problems associated with social isolation become more acute, particularly during the winter.

Most of our communities are larger than Baldur and have populations ranging from 1000 to 4000. Even in these larger towns about one quarter to one third of the population is over the age of 65. Like Baldur these communities developed in support of agriculture. None have public transportation systems so transportation of their mobility disadvantaged people becomes a community problem. The solution to this problem becomes a community project.



MANITOBA COMMUNITIES
OPERATING HANDIVAN
SERVICES

It is at this stage that we generally learn of the handivan project. Someone phones our office requesting information. Our program is strictly reactive to community initiative. But when the enquiry is made we offer to help the community in any way we can. This includes attending meetings in the town to describe our program. As can be expected, people are interested in what grants are available, what the rules of the program are and how they can apply for the grants.

We have tried to keep the rules very simple. The philosophy on which the program is based is that the community knows better than anyone else what its needs are. It knows what its resources are such as people, infrastructure, organizations and finances. Therefore the community is best able to put together a service which will best meet its needs at the lowest cost to it.

The Manitoba program requires one municipal government to sponsor the handivan service. Other contiguous municipal governments, where the family farm is probably located, usually join in financing the service.

A series of grants are provided to sponsoring municipal governments. These are:

1. a one-time start up grant of $6,000 to reduce cash flow problems during the start-up period;

2. a capital grant of 50% of the cost of an asset such as a handivan to a maximum of $10,000 for the original vehicle but not for its replacement;

3. an annual operating grant of 37½% of the gross operating expenses to a maximum of $20,000 per year.

These grants are intended to assist a community in establishing a handivan service. They were never intended nor will they buy and maintain a community handivan service. A handivan costs about $35,000. The community's share of this is $25,000. The community must raise 62½% of the operating costs. Because the community must raise a significant proportion of the funds it is free to organize and operate its service in any manner it chooses provided that the service is available to all eligible users. An eligible user is a mobility disadvantaged person

> "... who by reason of illness, injury, age, congenital malfunction or other permanent or temporary incapacity or disability is unable without special facility or special planning or design to utilize available transportation facilities."

It is necessary for the organizers of a service to convince their local municipal council to act as sponsor. This is where the real work begins. Council will want to know how many people will need the service - seniors; people with physical, mental or visual handicaps; school children in

wheelchairs with no transportation after school hours; the temporarily disabled with the broken leg who cannot get to work in his own vehicle. Council will also want to know why the present method of transportation is not good enough. They will want to know what it will cost to start and operate the handivan service. This means the organizers must resolve the issue of organization and how the service will operate. The most difficult question council will ask is how all of this is to be paid and what the organizers want council to do - both in the near term and over the long term.

Each community has special and unique needs which must be considered when establishing a transportation service for the mobility disadvantaged. The level of potential demand must be reviewed. In smaller communities where the level of demand is low, the operation can rely on volunteer drivers or employees attached to hospitals or personal care homes. This system will not work in larger communities where the van is in operation for most of the day. In these circumstances a variety of methods are used to staff the operation ranging from hiring staff directly to contracting the operation to other transportation services, such as the ambulance operator. These types of arrangements are more costly but avoid the problems of trying to administer a major volunteer program and a mobility disadvanataged transportation service at the same time.

In practice, we have 27 communities in our program and despite many similarities there are 27 different types of organizations and systems.

Since the program started in 1981 the program has grown rapidly. Program growth and the growth in funding can be seen in Table 1. In 1981/82 we funded four handivan services at a cost to the province of $40,000. Last year grants paid to 27 communities totalled $182,500. This year a budget of $398,000, of which $318,000 is to cover operating grants, has been approved. The large increase this year was brought about by the rapid increase in number of operations approved at the end of 1984/1985 but which did not get into actual operations until late last year.

Operating costs including depreciation vary considerably from community to community as can be seen from Table II.

In 1984 operating costs in those communities providing services for the whole year varied from about $8,000 to a high of about $59,000. The three services whose costs are above $50,000 all hire drivers and dispatchers either directly or by contract. They are also the busiest transportation services. The next busiest and next highest cost - about $37,000 is a community where the handivan is operated under contract by the operator of the community ambulance service.

TABLE I

GRANT PAYMENTS

PROGRAM OF THE TRANSPORTATION OF THE
MOBILITY DISADVANTAGED IN RURAL MANITOBA

COMMUNITY	Grant Type	Actual 81/82	Actual 82/83	Actual 83/84	Actual 84/85	Actual 85/86	Projections 86/87
Arborg	Start-up						
	Capital		1715				
	Operating						
Baldur	Start-up			6000			
	Capital			3763	308		
	Operating				2952	3620	5200
Boissevain	Start-up			6000			
	Capital			10000			
	Operating			1751	6308	5768	7500
Beausejour	Start-up					6000	
	Capital						10000
	Operating						7000
Carman	Start-up					6000	
	Capital						10000
	Operating						6500
Dauphin	Start-up				6000		
	Capital				10000		
	Operating					3900	20000
Deloraine	Start-up				6000		
	Capital					10000	
	Operating					3600	7500
Elkhorn	Start-up					6000	
	Capital						10000
	Operating						7000
Emerson	Start-up			6000			
	Capital			3763	497		
	Operating				2647	3301	4300

COMMUNITY	Grant Type	Actual 81/82	Actual 82/83	Actual 83/84	Actual 84/85	Actual 85/86	Projections 86/87
Gimli	Start-up			6000			
	Capital			3763	1725		
	Operating				12783	19179	20000
Glenboro	Start-up			6000			
	Capital				10000		
	Operating					4064	8600
Hartney	Start-up				6000		
	Capital				9954		
	Operating					2008	6200
Lac du Bonnet	Start-up				6000		
	Capital				10000		
	Operating					3862	9800
Minitonas	Start-up					6000	
	Capital						10000
	Operating						10900
Minnedosa	Start-up			6000			
	Capital			10000			
	Operating				4490	4045	6200
Morden	Start-up			6000			
	Capital			3763	766		
	Operating				3154	8078	12000
Neepawa	Start-up	6000					
	Capital				10000		
	Operating		9336	9709	11210	13961	20000
Pilot Mound	Start-up					6000	
	Capital						10000
	Operating						7000
St. Pierre	Start-up				6000		
	Capital				10000		
	Operating					1635	6000
Selkirk	Start-up	6000					
	Capital		10000				
	Operating		5882	17198	23406	20000	20000

COMMUNITY	Grant Type	Actual 81/82	Actual 82/83	Actual 83/84	Actual 84/85	Actual 85/86	Projections 86/87
Souris	Start-up			6000			
	Capital				9954		
	Operating			1758	2830	2909	7800
Steinbach	Start-up						
	Capital						10000
	Operating	12337	12600	4164	4916	3057	10600
Stonewall	Start-up				6000		
	Capital				10000		
	Operating					2851	17100
The Pas	Start-up						
	Capital			3763	501		
	Operating	16073	14740	20000	19049	19275	20000
Thompson	Start-up				6000		
	Capital				10000		
	Operating					10763	20000
Vita	Start-up			6000			
	Capital				9828		
	Operating						7500
Winkler	Start-up				6000		
	Capital				10000		
	Operating					5647	16600
Winnipegosis	Start-up				6000		
	Capital				9954		
	Operating					1024	10700
Total		40410	54273	147395	271232	182547	362000
Provision for Expansion							36000
Total Budget							398000

TABLE II
PROGRAM FOR THE TRANSPORTATION OF THE
MOBILITY DISADVANTAGED IN RURAL MANITOBA
1985 OPERATING DATA

COMMUNITY	Kms Trav.	Average Trip Distance Km.	Gross Operating Expenses $	User Fees Collected $	Cost Per Km $	1985 Cost Per Trip $	1984 Cost Per Trip $
Baldur	354	.8	9654.00	991.95	27.27	20.50	24.68
Boissevain	25480	5.8	15382.00	5068.00	.60	3.51	2.92
Dauphin	3000	13.6	10401.00	590.00	3.47	47.28	
Deloraine	1026	4.2	9650.00	281.40	9.41	39.88	
Emerson	7684	42.5	8803.00	1660.11	1.15	48.64	95.39
Gimli	61662	5.6	51144.00	14356.50	.83	4.69	5.37
Glenboro	3280	9.5	10389.00	972.34	3.17	30.20	
Hartney	15558	16.2	5355.00	6420.02	.34	5.57	
Lac du Bonnet	1552	13.0	10299.00	440.25	6.64	86.56	
Minnedosa	5010	8.5	10786.00	2695.18	2.15	18.31	38.12
Morden	23280	8.2	21541.00	6973.00	.93	7.56	8.77
Neepawa	14261	3.2	37228.00	8261.54	2.61	8.26	8.29
St. Pierre-Jolys	868	12.8	4360.00	338.70	5.02	64.12	
Selkirk	39236	3.4	59108.00	15967.00	1.51	5.07	7.39
Souris	15578	5.2	7758.00	3533.00	.50	2.59	3.85
Steinbach	7610	13.4	8152.00	2107.50	1.07	14.35	3.19
Stonewall	2711	11.8	7602.00	587.00	2.80	33.20	
The Pas	17234	2.0	51400.00	17514.25	2.98	6.01	5.06
Thompson	9290	3.2	28701.00	6603.00	3.09	10.00	
Vita[1]							
Winkler	5905	9.8	14659.00	1556.00	2.48	24.23	
Winnipegosis	500	16.8	2731.00	188.60	5.46	28.74	
TOTAL	261079	--	385103.00	97105.34	--	--	
Averages	12432	4.9	18338.00	4624.06	1.48	7.20	6.02

1 Vehicle was received too late for operations to commence during 1985.

Boissevain is interesting. This community of 1,600 people has the second lowest operating cost per trip of $3.51. Here the handivan is based at the senior's Beckoning Hills Activity Centre located on the town's main street. Dispatching is done out of the municipal office. Part time and volunteer drivers based at the Activity Centre operate the handivan.

Souris, population 1,731, has the lowest cost per trip - $2.59. Dispatching is done by the hospital staff and volunteers look after the driving. One of the needs at Souris was to transport mobility disadvantaged people to and from church. Their solution was to draw up a roster whereby each of the half dozen churches provided a qualified driver for a certain Sunday. The driver picks people up and transports them to and from the churches of their choice. Because each church only has to do this about once a month it is not an onerous task. As one clergyman said, "They have eliminated my job of conducting services at the personal care home and I am delighted".

Table II provides other interesting comparisons. The average trip length for all services was 4.9 kilometres. However, between the communities the average distance varied from 0.8 kilometres in Baldur to 42.5 kilometres in Emerson. These data reflect the differences in community needs and vehicle usage. In Baldur 63% of the population of 344 is over the age of 65. The Personal Care Home is attached to the hospital. Most of the trips are within the village.

Emerson makes a significant proportion of handivan trips to transport patients to and from medical treatment in other communities where the regional health services are located. This is a less expensive form of transportation for patients confined to a wheelchair than using an ambulance. The average cost per trip at Emerson was $48.64.

The Gimli handivan service travelled more kilometres than any other of our handivan programs and made 10,914 one way trips. Gimli, located on the west shore of Lake Winnipeg, provides handivan service to the Village of Riverton 44 kilometres to the north and to the Town of Winnipeg Beach 15 kilometres to the south. In order to reduce travel and operate more efficiently the Gimli handivan service arranged for adult day care, medical, dental and other appointments for Riverton's mobility disadvantaged people to be on the same day. Gimli trips support adult day care and mental retardation programs. However, most of the trips are for the transportation of seniors. Gimli has been so successful in serving its mobility disadvantaged at a gross operating cost of $4.69 per trip that it is now forced to obtain a second vehicle. The population served by the Gimli handivan service is not large as can be seen in Table III.

TABLE III

Population served by Gimli Handivan Service

R.M. of Gimli	2,375
Town of Gimli	1,550
Town of Winnipeg Beach	565
Village of Riverton	657
	5,147

The average operating cost per trip for the communities in our program in 1985 was $7.20. Perhaps it might be expected that the cost per trip would be lower in larger centers where economies of scale may be achieved. This is not bourne out by the facts. In Winnipeg, Handi Transit carried 79,317 mobility disadvantaged people at an average cost of $20.64. Costs in those communities which operated for the full year are lower than this due to a large extent on their ability to use volunteer labour or part time labour at incremental costs. Certainly a central provincial agency could not achieve these costs.

The Manitoba Program for the Transportation of the Mobility Disadvantaged in Rural Manitoba provides a grant which covers only 37½% of gross operating costs. While the community must raise the remaining 62½% of the cost of the service, it is free to do so in any way it chooses. We do suggest that about 25% of operating costs should be recovered through user fees. In 1985, those communities which had been operating for a full year collected an average of 28% of operating costs in user fees. They varied between communities from 10% to 45% of operating costs. Table IV indicates the wide variety of user fees charged by the communities, ranging from 75¢ to $4.00, or an average $1.39 per trip.

User fees reflect community needs and differences. The handivan service was established at Pilot Mound where the Personal Care Home is located. The district hospital is in Crystal City about 10 kilometres away. Crystal City, Clearwater and the Rural Municipality of Lousie all support the handivan service. As a result, the user fee of $1.00 per trip applies to a trip anywhere in these municipalities. The out of town charge of 50¢ per kilometer applies only after leaving the rural municipality.

The proportion of operating cost collected as user fees is a local matter. That portion of the cost not covered by users fees is also a local matter and is the responsibility of the community. How this is done varies between communities.

Stonewall has a formal five year agreement with the three Rural Municipalities of Rockwood, Rosser and Woodlands. The deficit is covered on a per capital formula which takes potential users of each municipality into consideration.

The Town of Neepawa and three contiguous rural municipalities have guaranteed to cover any deficit. After four years of operation, the handivan service has never requested funding from the municipal governments.

One new community advised me informally that that Council will increase the mill rate to finance the handivan. The operators of the handivan service have not been advised of this intention. Council wants to see how economically the service can be run and what other sources of funding can be found before formally agreeing to fund the deficit.

TABLE IV
HANDIVAN FARES AS AT DECEMBER 31, 1985

COMMUNITY	One Way Trip in Town	One Way Trip out of Town	Return Trip in Town	Return Trip out of Town	No. of Person Trips in 1985
Baldur	$ .75		$1.50		471
Boissevain	$. 75	$ .75 plus .24/km			4386
Dauphin	$2.50	$ .20/km			220 *
Deloraine	$1.00	$1.00 plus .15/km			1026 *
Emerson	$1.50	$ .20/km			181
Gimli	$1.00	$1.50/ person	$2.00	$3.00/person	10914
Glenboro	$ .75	$ .15/km			344 *
Hartney	$1.00	$1.00 plus .35/km			962
Lac du Bonnet	$1.00	$2.00 within 3 km radius			119 *
Minnedosa	$2.00	$2.00 plus .22/km	$4.00	$2.00 plus .22/km	589
Morden	$1.50	$1.50 plus .25/km	$3.00	$3.00 plus .25/km	2848
Neepawa	$2.00	$2.00 plus .32/km		$2.00 plus .32/km	4508
Pilot Mound	$1.00	$1.00 plus .50/km	$2.00	$1.00 plus .50/km	Ø *
St. Pierre	$1.50	$1.50 plus .32/km		$1.50 plus .32/km	68 *
Selkirk	$1.25	$1.75			11661

COMMUNITY	One Way Trip in Town	One Way Trip out of Town	Return Trip in Town	Return Trip out of Town	No. of Person Trips in 1985
Souris	$1.00	$1.00 plus .35/km			2990
Steinbach	$4.00	$1.00/mile	$8.00	$1.00/mile	568
Stonewall	$1.25	$1.25 plus .22/km to $4.00 max.			229 *
The Pas	$1.75	$3.00			8559
Thompson	$2.00	$10.00 to the airport			2959
Vita	$ .75	$ .75 plus .30/km			6 *
Winkler	$1.50	$1.50 plus .25/km		$1.50 plus .25/km	605 *
Winnipegosis	$1.00	$ .30/km			95 *

* New communities which entered the program during 1985.

Beausejour's new service is guaranteed an annual grant from both the town and the rural municipality for the first three years. The Gimli operation receives grants ranging from $300 to $3,000 from six municipal governments. They also raised $5,398 of the $51,000 in operating costs through bingos and fish fries.

Several communities have capitalized on the problem of what to give a senior for Christmas or birthdays. Most seniors do not want physical gifts that take up space because they have been trying to reduce their possessions. A number of communities offer gift certificates which are good for rides on the handivans. Winnipegosis has its "handibuck". Somehow, even though some seniors would not spend money to use the handivan service, a gift certificate is seen differently. Perhaps this happens because it does not seem like money and in any event it cannot be used for anything else. These gift certificates and handibucks help to get seniors and other mobility disadvantaged people out of their homes and into various activities which reduces their social isolation.

The diversity of community need is indicated in Table V, which summarizes the program's 1985 operating data. Of the 53,500 trips 29% were for employment and school purposes, 31% for medical and adult day care reasons and 40% in support of improved quality of life. These "quality of life" trips were for business reasons, shopping, visiting, recreation and an "other" category.

In The Pas almost three quarters of all trips were for school purposes. In Selkirk and Steinbach one quarter to one third of all trips are for employment reasons usually transporting people from a group home for mental retardates to workshops. In Souris and Hartney about 90% of all trips are in support of Adult Day Care programs. Almost half of Deloraine's trips are shopping and business related. In six communities recreation trips account for more than half of the trips. In Glenboro 99.4% of the trips were for recreational purposes.

In Manitoba some school buses are equipped to handle pupils confined to wheelchairs. As the school bus can only be used for school purposes these children have a great difficulty attending athletic functions or social activities such as birthday parties. Our handivan program is used to help these children lead more normal lives. You can imagine how one girl blossomed when, despite being confined to a wheelchair, she became one of the basketball cheerleaders.

Not all "mobility disadvantaged" persons receive transportation. It seems that one summer evening one individual had been celebrating long and well. By 3:00 a.m he was unable to drive home so he phoned for the handivan and told the handivan driver that he had a mobility disadvantage. His request was turned down as his home was only a block or so away from the scene of his celebration.

TABLE V
PROGRAM FOR THE TRANSPORTATION OF THE
MOBILITY DISADVANTAGED IN RURAL MANITOBA
1985 OPERATING DATA

COMMUNITY	No. of One Way Trips by Trip Purpose								
	Employ -ment	School	Medical	Adult Day Care	Shop Bus.	Visit -ing	Recrea -tion	Other	Total
Baldur			31				285	155	471
Boissevain	192		1000		433	400	2341	20	4386
Dauphin			13	40	10	9	40	108	220
Deloraine			21	1	114	29	70	7	242
Emerson			69		38	6	53	15	181
Gimli	1104		760	2496	1423		5131		10914
Glenboro			1		1		342		344
Hartney			12	905			45		962
Lac du Bonnet			16	86			17		119
Minnedosa			202	186	5		196		589
Morden	127		992	858			871		2848
Neepawa	6	693	1576	694	247	234	1058		4508
St. Pierre-Jolys			5	25			38		68
Selkirk	4303	18	1536	1289	2297	688	883	647	11661
Souris			104	2598			249	39	2990
Steinbach	141	214	110				103		568
Stonewall	32		39		93	4	61		229
The Pas	136	6277	373		374	242	919	238	8559
Thompson	401	1887	234	92	91	1	253		2959
Vita[1]									
Winkler		36	87	63	69	64		286	605
Winnipegosis			33			16	46		95
TOTAL	6442	9125	7214	9333	5195	1693	13001	1515	53518

1 Vehicle was received too late for operations to commence during 1985.

This description of our program has concentrated on the statistical approach. The real value of the program can only be learned from some of the stories behind these trips. Many of the recreation trips are to bingos - a major form of entertainment for many people. But frail seniors who may not have been able to get out in the winter or in the evenings can be picked up at home and transported easily, in safety and at a reasonable cost.

Many seniors in personal care homes who are confined to wheelchairs find it very difficult to attend family celebrations. Trips to weddings, funerals and other family events are often listed in the "other" category on Table V.

The first weekend that the handivan was in Stonewall, a group of seniors from one of the personal care homes were taken on a trip to their old home village on Hecla Island (now a provincial park). Excursion trips are taken from Boissevain and Deloraine to visit the International Peace Garden straddling the Manitoba-North Dakota border. One community took a group of seniors into Winnipeg to a Jets hockey game. Three communities - Selkirk, Gimli and Stonewall are organizing a joint picnic for frail elderly personal care home residents, who once lived, worked and raised their families in the same district.

The Society for Manitobans with Disabilities operate a fully accessible barrier free camp near Gimli. Several communities are organizing "camping trips" for their mobility disadvantaged seniors living in personal care homes. Outings like this, to a camp overlooking Lake Winnipeg, contribute greatly to the quality of life of the elderly personal care home residents.

Listed under the "shopping" category are the trips taken by one lady in her mid 80's who lives alone. Her family looked after her shopping needs every weekend. Grandchildren visited faithfully every Tuesday at 4:00 o' clock to see if Granny needed anything. Someone from the handivan service visited her and asked her why she did not use the Handivan. She was surprised that it was for her to use as well as the people in the personal care home. After about 20 minutes of discussion she was convinced that she could use the handivan - even to go shopping. At this point she ordered the handivan to pick her up on Tuesday at fifteen minutes to four. When the family arrived at four o'clock Granny was not at home. She was shopping. After this the family began to notice changes in Granny. They could never be sure that they would find her at home. She suddenly became more like the dynamic lady that she had been earlier. She has a measure of independence once more. This story was told by the family who were delighted by the change but now can never quite count on Granny to be at home.

This is what it is all about. One very generous worker responsible for Manitoba's Adult Day Care Program said:

> "The transportation program has offered more to the quality of life for rural Manitoba seniors than any other program of government in the last 20 years."

As she is the expert I will not argue the point.

From the point of view of the users of the mobility disadvantaged transportation services who have been able to relieve their isolation and regain a sense of independence through increased freedom to move, the program is highly successful. From the point of view of someone administering the program, it is highly rewarding.

WG/SG:EXPO-PAPER

CANADIAN ISSUES IN RURAL AND SMALL URBAN TRANSIT SYSTEMS FOR THE DISABLED

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1. BACKGROUND

A great variety of transit service options for the elderly and the disabled exist throughout Canada. Most of the elderly and the ambulatory disabled are able to use conventional transit services. The operators of conventional transit services have undertaken significant modifications in an effort to make the conventional transit services as accessible as possible. Accessibility to conventional transit systems has generally not been a major issue because of the provision of high-quality parallel systems and services in most urban communities.

Residents of small communities and rural areas who are elderly, disabled, or otherwise mobility disadvantaged often have a greater need for specialized forms of transportation than those who reside in cities. The reasons for this are as follows:

- Conventional public transit systems generally do not exist in communities of less than 10,000 persons.
- Small communities may not be able to provide sufficient business to support a taxi company.
- Distances to major local activity centres are usually greater due to the necessity of centralizing of institutions.
- Low density and linear rural development patterns increase walking distances and feelings of isolation.
- Remote employment locations may reduce the availability of automobiles during the day.

There are two basic transit services used in small communities and rural areas. These include subsidized taxi systems using conventional automobiles and systems using small buses and vans, often equipped with wheelchair accommodation. Some communities have two or more of these services in effect.

The following table shows an estimate of the percent (represented by population) of the urban communities of Canada that had transit service for the disabled in early 1986.

Communities under 5,000 persons	15% served
Communities of 5,000 to 25,000 persons	25% served
Communities of 25,000 to 100,000 persons	60% served
Communities of 100,000 to 500,000 persons	92% served
Communities over 500,000 persons	82% served
Total for Canada	73% served

2. ORGANIZATION OPTIONS

Transit services for the elderly and disabled are delivered in a great variety of ways in small communities and rural areas. A specialized transit service may be provided through the following organizations:

- municipal departments;
- municipal contracts;

- transit commissions;
- service clubs;
- senior citizen associations;
- social service agencies;
- private societies;
- associations for the handicapped;
- community action groups;
- institutions (e.g. hospitals).

In most cases the transit service is provided through contractual arrangements with the municipality or municipalities served. The majority of operators in small communities in Canada are non-profit associations or societies. In several communities, more than one type of service is delivered by co-operating agencies. Frequently, for example in Quebec and Alberta, the system provided is shared by two or more municipalities.

3. SERVICE POLICY ISSUES

Transit service policies are often a reflection of the organization delivering the service. It is not surprising that senior citizens associations tend to develop systems that primarily service the elderly, while community action groups tend to respond to broader needs. Service policies include both eligibility criteria and system characteristics. Since the words used affect eligibility rules, a list of definitions of terms in common usage has been included at the end of this paper. Typical service policies include:

- eligibility criteria and priorities;
- trip priorities;
- pricing policy;
- hours and days of service;
- service area.

The most common eligibility criteria for special transit systems in small communities (in descending order of inclusiveness) are as follows:

- all persons may use service;
- all mobility disadvantaged may use service;
- all elderly and disabled may use service;
- all adult elderly and disabled may use service;
- elderly only may use service;
- disabled only may use service;
- those with special needs only may use service.

Typically the eligibility criteria for elderly and disabled persons fall into three categories in Canadian systems:

- the Elderly and the Disabled, i.e. 12-15% of the population eligible (e.g. communities in Alberta, Saskatchewan and those without conventional transit service in British Columbia);
- the Disabled, i.e. 2-3% of the population unable to use conventional transit (e.g. communities in Quebec, the Yukon, Newfoundland, and in British Columbia);

- the Physically Disabled, i.e. 1-2% of the population unable to board conventional transit (e.g. communities in Ontario, Manitoba and Nova Scotia).

Most small systems designed for elderly and disabled passengers assign trips or make vehicles available for service for the following purposes in descending order of priority:

- medical appointments;
- shopping and personal business;
- social/recreational;
- charters or out-of-town excursions.

Systems that cater to a larger segment of their community population (all of the mobility disadvantaged) may also include the following trips with priorities similar to those for medical appointments:

- work trips;
- school trips;
- service for daycare centres;
- hospital visiting;
- patient travel for nursing homes and auxiliary hospitals;
- physiotherapy access.

Most systems offer trips on a first-called, first-served basis. Most systems usually must limit total trips so as not to exhaust available funds. Many systems do not operate at night or on Sundays and holidays.

Pricing policies vary widely. Some systems are "free" to the user. Some provide a vehicle and the users are expected to pay the operating costs. The subsidized taxi systems usually collect part of the taxi fare from the users. This amount may vary with vehicle occupancy.

The subsidized taxi systems provide the highest level of service to the elderly and ambulatory disabled with unscheduled service that is on-demand to the users. The dispatcher quickly becomes familiar with repetitive trips and schedules extra taxis as needed. Taxis tend to cruise in areas where trips originate (e.g. hospitals, senior citizen lodges, activity centres, etc.).

Van and bus services are usually prescheduled at least 24 hours in advance. Those equipped with two-way radios could accept last-minute requests, but this is not usually the case because of the lack of back-up vehicles. Many systems require bookings of from one to three days in advance for local trips. All require substantial notice for scheduling of excursion trips.

Except for systems in the Province of Quebec, formal routes of appeal over eligibility rules and regulations are not common. This is not usually a problem because the political process helps to keep local agencies and municipal councils responsive to user needs. In most cases, a user denied service would likely appeal first to the provider organization and then to the municipal council. Eligibility criteria tend to be less rigidly enforced in the smaller communities.

4. COST CONTROL ISSUES

For those of the ambulatory disabled who are unable to use conventional transit services but who do not require a lift-equipped vehicle, taxis are often used. In the Province of Quebec, for example, eligibility committees are established that help to channel disabled persons, in accordance with their degree of disability, toward the means of transport best suited to their needs. This often results in the use of taxis.(1) In the large cities of Hamilton, Calgary, and Edmonton, for example, taxis are used very effectively. In Edmonton, taxi companies are also operating van services for the disabled.

Whether formal arrangements exist or not, taxi companies in small communities often provide subsidized taxi services. Such communities can generally cater to the elderly and the disabled without adding staff. The taxi drivers usually try to be in the areas that need service at a particular time so that dispatching is simplified. For example, if a particular senior citizens home generates trips at regular times, taxis will wait there for trips. This reduces the demand on the dispatching facilities. The cost of dispatching is usually included in the flat rate charged for the taxi service. If local bylaws permit, taxi companies can operate larger vehicles such as vans and small buses.

The operating staff for many formal systems include volunteers, part-time employees, full-time employees, flat-rate payments to staff, and combinations of the foregoing. Often the vehicles are being dispatched from public service offices at no administrative cost to the system. Drivers may be involved in maintenance of vehicles in small systems.

For analysis purposes, the most useful data and statistics that can be obtained for communities and systems providing special transit services include the following:

- population served;
- percentage of senior citizens in the population (age 65 and over);
- number of handicapped persons in the community;
- system ridership;
- system operating costs;
- system revenues (if any);
- value of contributed services and/or administrative costs.

Very few systems have the time and staff to provide more information than this. Funding agencies requesting data should realize that their needs may impose added administrative costs on these small systems.

It is important to know the total population served by the system including the portions of rural areas if applicable. Transportation needs generally increase faster than the population as travel distances exceed comfortable walking distances. Population size is therefore a good initial indicator of potential transit demand. The elderly component of the population, which includes many handicapped persons, is the main indicator of the potential demand for special transit services.

5. PROVINCIAL FUNDING

Eligibility criteria for transit services for the disabled in local communities (with the exception of communities in New Brunswick and Prince Edward Island) reflect provincial funding policies. Such funding policies and any related provincial guidelines for service operators are based on current provincial goals and objectives with respect to both social and transportation issues that are unique to each province.

In British Columbia, for those communities that do not have conventional transit services, a form of paratransit service is provided. This paratransit service utilizes small, lift-equipped buses to serve all persons in the community. Similar systems have been utilized successfully in other provinces. Alberta,Saskatchewan, Manitoba and Quebec have funding programs designed to take care of the needs of the disabled in rural and small urban communities. These funding programs are discussed in the following sections.

(a) Alberta

The Province of Alberta has a unique Public Transportation Operating Assistance Grant (PTOAG) program.(2) All towns, villages, rural municipalities, municipal districts, and "special areas" have received per capita grants yearly since 1980. More than one hundred communities have used these funds to provide some form of paratransit service. The only requirement is for the community to report annually as to the types of projects funded. Those cities that are operating a public transit system receive $8.00 per capita plus $3.00 for any special transit services for the elderly and/or the disabled that are provided. Smaller cities where conventional transit is not present and larger towns with a paratransit system receive $3.00 per capita plus $3.00 for transportation of senior citizens and the disabled. All other jurisdictions receive $3.00 per capita for the transportation of the elderly and disabled.

(b) British Columbia

The provision of all types of municipal transit services (conventional, paratransit and custom transit for the disabled) is the responsibility of BC Transit, a provincial Crown corporation. The provision of transportation services for the elderly and disabled falls under the Custom Transit Services program of BC Transit. In the smaller communities, BC Transit enters into tri-party annual operating agreements with local municipalities and transport operators who agree to provide a stipulated number of annual hours of service in a defined area and adhere to an agreed-upon annual service budget. In communities which are too small to sustain conventional transit services, ambulatory and disabled persons may be served by a dual-purpose "paratransit" system. Custom transit vehicles are usually purchased by BC Transit and then leased to operators.

In 1985, financial assistance was being provided for custom transit services in twelve communities and for paratransit service in another ten communities. Eligibility for the service is guaranteed for persons who are registered for the service and who are unable to use conventional public transit without assistance. Income and age are not considerations.

(c) Manitoba

The Department of Highways and Transportation manages the Program of the Transportation of the Mobility Disadvantaged in Rural Manitoba. In 1985, there were 22 rural communities participating in this program. The program requires a municipal initiative with technical support provided by the Province. The Province outlines the minimum requirements for vehicles, user eligibility and service levels. There is provision for a one-time start-up grant of $6,000 plus capital grants of 50 percent to a limit of $10,000. Operating grants are provided on the basis of 37.5 percent of operating costs to a limit of $20,000.

(d) Quebec

Most special transit services for the disabled are operated by the local public transit systems or regional systems that provide service to several communities. Provincial funding is provided through the Ministry of Transport.

Special transit services for the disabled offer on-demand, door-to-door service. The services generally use minibuses and require advanced registration. Some 55 transit delivery organizations for the disabled have been created since the inauguration of the program in 1979. Nearly 400 of Quebec's 1,500 municipalities are served, covering almost 70 percent of the population.

Access to transit services for the disabled has been governed since 1983 by a provincial policy aimed at standardizing the criteria for eligibility across Quebec and a maximum usage by the disabled of the least specialized types of service suitable for their needs. Compulsory creation of eligibility committees, comprised of municipal representatives and those representing the disabled, has permitted the channeling of eligible persons, in accordance with their degree of handicap, towards the means of transport best suited to their transportation needs. For example, the use of taxis is greatly encouraged.

(e) Saskatchewan

Funding for the Province's "Transit for the Disabled Program" is provided through Saskatchewan Urban Affairs. The Province provides up to 75 percent of the cost of acquiring specially-equipped vehicles and 50 percent of any operating deficit. The balance of the operating deficit is a local responsibility. Municipalities applying for assistance are required to provide a door-to-door transit service for the disabled.

The vehicles are owned by the municipalities, who have the responsibility to set fares, hours of service and other operating policies. A third party may operate the service on behalf of a municipality.

6. CURRENT NEEDS AND ISSUES

In 1985, there were approximately 330 operators of special urban transit services for disabled persons in Canada operating more than 1,300 vehicles at an annual cost, excluding capital, of 60 million dollars. Two-thirds of these systems were located in small communities, while most of the costs (84%) were incurred by urban communities of 25,000 or more persons.(3) The major significant features of transit service for the disabled in Canada include:

- a rapid implementation of new systems since 1981;
- an explosive annual growth rate in ridership averaging 13 percent nationally;
- a demand level exceeding the capacity of many systems, particularly those in the larger communities;
- a need for organization and management strategies to cope with growth;
- a great variety of delivery mechanisms;
- a great variation in eligibility criteria by province;
- an expressed need for both management and staff training.

The top five organization needs identified by the operators of these services during a recent survey included:

- a strategy for growth;
- a need for more system capacity;
- a need for more hours of service;
- a need for more funding;
- training for management and staff.

The top ten management needs identified by the small community operators included:

- management strategies to cope with growth and change;
- comparative data from other systems;
- training for management and staff;
- planning guidelines and indicators;
- lobbying support;
- maintenance guidelines;
- vehicle specifications;
- standardized insurance;
- information on provider options;
- guidelines for organization.

Current issues in E & H transportation services were identified in a recent study undertaken by MANOP Services Ltd., for the Canadian Urban Transit Association (CUTA). The following list of issues is a result of CUTA activities to date, including a comprehensive national study and analysis of the needs of the 330 operators of paratransit services for the disabled in Canada undertaken by CUTA during the period September 1985 through March 1986.(3)

- Are current levels of funding adequate? (For example, when the transport agencies absorbed pre-existing social programs, the related funding often did not come with the service responsibility.)

- Is the distribution of funding between the various levels of government appropriate? (At present most federal assistance is going to small communities because of perceived needs.)

- Are the users paying an adequate share of the costs? (When conventional transit fares averaged $0.50, the disabled paid $1.00 or more on most services. Now both conventional transit and special transit fares average $1.00.)

- Should the majority of the ambulatory disabled be carried on conventional transit, i.e. denied access to special transit, or are there other ways to accommodate the ambulatory disabled at a more reasonable cost? (Note the current policy in Quebec to use the least-cost alternative.)

- Are current eligibility rules and criteria appropriate? (Should there be common eligibility criteria across Canada?)

- Can taxis be used to a greater extent without major organizational and labour difficulties?

- Can private enterprise be used to a greater extent? A recent paper discussed this option in detail.(4)

7. CONCLUSIONS

There is an apparent need for the implementation of more transit systems and services designed for the elderly and the disabled in the small urban and rural communities of Canada. The cost of financing these systems should not impose a major additional burden on provincial funding agencies since a relatively small population is involved.

Several techniques have been used by provincial funding agencies to keep the cost of funding such services under control. These techniques have included:

- The design of dual-purpose systems so as not to have to fund both conventional transit services and special transit services.

- The extensive use of non-profit delivery agencies.

- The encouragement of least-cost service options such as taxi systems for the ambulatory disabled.

- The provision of per capita seed money rather than imposing a formal structure on the municipalities.

From a review of the number of small urban and rural transit systems operating in each province it is apparent that those provinces with a "top down" administrative process deliver fewer systems to the users than those provinces who encourage more local initiatives. This issue was expected to be debated further at the opening session of the current conference.

The elderly and disabled sectors of the population are increasing, both as a proportion of the population and in real numbers. Many such persons wish to remain in their home communities, given adequate mobility. Should this mobility fail to be provided, challenges can be expected under human rights legislation.

The operators of conventional transit services have been improving the accessibility of their systems wherever possible, and to date (with the exception of a current action in Saskatoon, Saskatchewan) have not been challenged under human rights legislation because of the availability of high-quality parallel services in most communities. Should such parallel services become overloaded due to substantial growth in demand with the result that the quality of the service deteriorates, this situation could change.

For those communities without either conventional or special parallel transit services, potential user groups and advocates should benefit by successful experience in other communities. The normal political process can be expected to respond to the need since the benefits are great for the relatively small expenditures required by senior governments.

DEFINITIONS

The following definitions include the terminology in common usage by the operators of special transit systems for the disabled in Canada.

The Disabled: for the purposes of this paper are defined as "persons of any age who have a physical, mental or medical condition, either permanent or temporary, that limits their mobility." This is a broad definition that encompasses some of the elderly, the obese, and those persons with injuries.

The Ambulatory Disabled: includes those persons who may experience some loss of function but who are not otherwise considered to be mobility handicapped. Many of such persons are normally able to use conventional transit services.

The Physically Disabled: includes those persons who use wheelchairs for mobility, and therefore require a specially-equipped vehicle.

The Elderly: are defined as those persons "AGED 65 OR MORE". It is recognized that while functional aging, whether biological, psychological, or social can begin long before a person reaches the age of 65, "the elderly" as defined are not necessarily mobility disadvantaged.

Paratransit: is defined as collective passenger transportation for the general public and/or special categories of persons on a regular and predictable basis through demand-responsive scheduling and/or flexible routing of vehicles. The term paratransit embraces dial-a-bus services, shared-ride taxi systems, publicly sponsored ridesharing, subscription bus services, airport limousine services, and jitneys, where legally and formally established.

Urban Transit: includes all forms of collective passenger transportation for the general public in urban areas.

The Mobility Disadvantaged: includes those persons who are unable to use conventional transit services for any reason without regard to their age or disability. The term is included here because some of the transit services for the disabled in small urban and rural communities allow such persons access to the special transit services. The Toronto Transit Commission has recently carried out a study of the needs of such persons for services that fall between conventional transit and the special parallel service.

The Handicapped: has the same meaning as The Disabled.

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"A TICKET TO RIDE" - ELIGIBILITY GUIDELINES FOR SPECIALIZED TRANSPORTATION SERVICES

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INTENT

This paper provides an overview of the role of eligibility guidelines for specialized transportation services. Eligibility is discussed as it affects each of the major stakeholders in the specialized services; the users, the service operators, and the funding agencies. The practical importance of eligibility guidelines is demonstrated by a review of the Ontario experience with its transportation program for disabled persons.

EFFECT ON STAKEHOLDERS

When discussing eligibility three stakeholders in the services are affected, the user groups, the service operators and the funding agencies. For this discussion three major aspects of eligibility are addressed. These are:

A. Need for an eligibility guideline - why a guideline should be established;

B. Responsibility for establishing the guideline - which level or participant in the service should be responsible for setting the guideline;

C. Scope of the guideline - how should the guideline be defined.

Any change to the eligibility guideline directly affects each or all of the stakeholders. The eligibility guideline provides the balance point between those two other vital components of specialized services, funding and service levels.

User Groups

1. Reasonable Assurance of Service Access

   For the user group the existence of an eligibility guideline is ultimately the service standard for the specialized facilities. The guideline establishes a standard against which an individual with a specific transportation need can be reasonably assured that an appropriate service will be provided. Without an eligibility guideline the user will be uncertain of acceptance for such services.

The eligibility guideline may be established at the senior or local government level. In Ontario, the senior level is the Province and the local level is the municipality. For the user, the establishment of the guideline at the local level is often deemed desirable. At this level, services can be constituted in a manner which would appear to best meet local or individual needs. However, in some instances these relatively new municipal services may not hold a high priority at the local level. Eligibility may be unreasonably strict to compensate for lack of local commitment, thereby affecting the potential user. When eligibility is constituted at the senior level, it may be perceived as softening the discretionary nature of guidelines established at the local level and thereby providing for a fairer treatment of one individual relative to another.

2. **Reciprocity**

   A common eligibility guideline provides for increased freedom of travel within the jurisdiction of a senior funding agency. With uniform eligibility individuals are assured that their eligibility for services in one municipality will be recognized in another.

For the user or potential user, the definition of eligibility is all important. User group attitudes and reactions to eligibility are varied. On one hand there is a tendency to seek the broadest possible interpretation of eligibility so that as many people as possible who have difficulty in using conventional transit facilities may have the benefit of access to specialized transportation. On the other hand, there may be a resistance to expansion of the eligibility guideline on the part of current users who recognize the potential of a diminution of present service levels as pressures from new user groups are placed on existing services.

Service Operators

For the operator, eligibility is a major factor in influencing systems operation and, therefore, the cost of providing the services.

1. Planning

   The operator will find the existence of an eligibility guideline all important. Service planning, especially in terms of vehicle type and fleet composition, is contingent upon the existence of an eligibility guideline. In the

absence of such a guideline, the operator has little or no basis for planning, either on a daily or longer term basis.

A defined eligibility guideline enables the operator to plan for current and future fleet size. The vehicle fleet can be composed as appropriate to meet the needs of defined user groups. Adjustments to the eligibility guidelines would necessitate reassessment of the vehicle fleet composition to ensure that it still meets the transportation needs of the targeted user groups.

2. Scheduling

In a mixed service fleet eligibility becomes an important factor in scheduling especially if eligibility is broadened and people with a wide range of functional abilities become eligible for service. Vehicle types in the fleet vary among operators, but often include dedicated vehicles such as buses, vans and cars as well as taxi services. To provide the most cost effective service it then becomes necessary to schedule trips to ensure the most effective use is being made of vehicles to meet the individual transportation needs of the passengers.

3. Productivity

Productivity levels are influenced by eligibility. Where services are restricted to only those with the most limited mobility functions, the time to provide proper services to the passengers increases and reduces the number of passengers who can be carried each vehicle hour. As the eligibility guideline is expanded to include people with fewer functional limitations, for example, ambulatory disabled persons, productivity can be improved. However, if a corresponding increase in service is not provided for when eligibility is expanded, then those users without alternate transportation options may be left without service.

4. Public Relations

For the service operator a well defined eligibility guideline is important for advertising and marketing the service and for dealing with passenger and public complaints and concerns. The eligibility guideline is a necessary standard against which the community can be assured that its citizens are being treated fairly and equitably. While the guideline may vary from jurisdiction

to jurisdiction, within any municipality the operator can only maintain credibility if the application of the guideline is consistent. When the guideline is established at the senior level, the operator has less difficulty responding to requests for service from non-residents who are eligible in their own municipalities.

In summary the operator faces a dilemma between the lower productivity of services geared toward the most disabled, and the greater costs and pressures involved in operating with a broadened guideline.

<u>Funding Agency</u>

In Ontario there are two levels at which funding is provided, the Province or senior level, and the municipality or local level. This discussion will focus on the importance of eligibility for the senior funding agency.

At the senior funding agency level the establishment of an eligibility guideline provides the basic direction for the transportation program. The guideline is the expression of the concern of the senior government linking its funding resources to the transportation needs of its citizens. The importance of the eligibility guidelines to the funding agency is far reaching:

1. Accessibility on Conventional Transit Facilities

   The scope of the guideline for eligibility on specialized services directly influences the level of changes which will be contemplated to make conventional transit facilities accessible. For example, if the assumption is made that the reasonable needs of non-ambulatory persons are being met on specialized services then the conventional services may only be modified to the extent that access to them is eased for ambulatory disabled persons. Another jurisdiction may make the decision that the needs of its citizens can only be met through the provision of both a specialized system and a fully accessible conventional system, or some other combination of services.

2. Subsidy Targeting

   The establishment of an eligibility guideline provides the funding agencies with their most basic means of ensuring that subsidy dollars are being reasonably directed to the intended users of the service. Given the high unit cost of

such services, it is of critical importance that available funds be directed to only those who are in greatest need of specialized service.

3. Reciprocity

The maintenance of reciprocity is important if citizens are to be able to travel throughout the jurisdiction, in this case, the Province. A single guideline established at the senior level is essential to ensure that each system will recognize the eligibility for its service of individuals registered with other municipalities.

4. Program Planning and Management

For the senior funding agency the ability to have a relatively consistently defined user group is important for long range planning. If an eligibility guideline is not in place, projecting program growth and future financing requirements becomes an imprecise exercise.

As the definition or scope of the guideline is expanded, total program funding levels will increase rapidly. A major 1985 Ontario review of eligibility demonstrated some of the effects of various market size scenarios on the subsidy requirements at both the senior and local level.[1] Eligibility guidelines are also essential for responsible program management. As well, for the purposes of program audit, it is necessary to have a guideline which is reasonably uniformly understood and applied.

5. Equitable Distribution of Subsidy

Funding agencies remain concerned that subsidy dollars be equitably distributed among municipalities. A program without a standard to which subsidy can be tied would result in an inequitable distribution of funds. In time this situation brings programs under scrutiny and attack. The eligibility guideline is the standard by which the funding agency ensures that distribution of funds is fair and equitable, that they do not flow in directions disproportionate to the need or requirement for them.

The concerns of the funding agency with the extent of eligibility encompass those of both the user groups and operators as well as its own concerns. The concerns of the funding agency relate to the ability to ensure greatly increased funding for a high level and quality of service if eligibility is broadened and demand increases.

ONTARIO EXPERIENCE - INTRODUCTION

The Ontario Setting

Before proceeding with a discussion of the Ontario experience with eligibility, it is important to outline the institutional framework within which Ontario specialized transit systems operate. It is intended to provide the reader with an appreciation of the principal differences that may exist between the Province of Ontario and other jurisdictions.

The local municipality is responsible for the provision of services either through a direct public operation, or a contractual operation. This responsibility extends to the setting of service standards and levels, fare policies and similar aspects of service provision.

A municipality raises its share of the cost of providing specialized transit services through the general property tax and is not allowed to impose any other levies. However, municipalities may accept charitable donations to assist in offsetting their share of the cost. The Province provides financial, technical and technological assistance to municipalities providing specialized transit services.

Program Evolution

The transportation program for disabled persons was initiated in Ontario in 1979. The program was preceded by three years of pilot projects involving five municipalities of varying size and geographic location and liaison with a multiplicity of other agencies and potential user groups. The program has grown quickly and significantly. It is anticipated that it will continue to grow for some years to come.

Since the Program inception in July 1979, the number of municipalities with specialized transit services has increased from 21 to 52, out of approximately 90 which have a potential to provide such a service. These 52 municipalities have a population of 6.49 million, representing about 80 percent of the total Provincial population. The level of services provided and passenger use have both shown dramatic growths with a six-fold increase in annual vehicle hours to a 1985 level of 744 thousand and seven-fold increase in passenger trips to 1.58 million. Provincial subsidy contributions have increased from 1.0 million dollars in 1979 to 11.6 million in 1985.

Current Policy

The Province of Ontario provides capital and operating funding for specialized transit services for disabled persons. This program is supplemented by a special rate of funding for features which will improve the accessibility of conventional transit facilities for ambulatory disabled persons. These features include courtesy seating, hand and grab rails, kneeling suspensions on buses, visual ear devices, and brightly coloured information signs.

Ontario has formulated its public transportation programs for disabled persons in this manner in the belief that this combination of approaches best meets the mobility needs of disabled users. It is recognized, however, that other jurisdictions have seen a need for other service combinations. These may range from no accommodation for ambulatory disabled users on conventional services to full accessibility to combinations of other paratransit services such as subsidized taxis or vanpools. Other jurisdictions may provide user side subsidies, permitting the individual to chose the type of service, if available, most suited to personal needs. However, whatever the approach, eligibility remains a central issue directly related to the means by which governments and service operators respond to meeting special transportation needs.

ONTARIO EXPERIENCE - ELIGIBILITY GUIDELINES

During 1985, Ontario conducted a major review of eligibility.[2] This study provided for extensive discussions among the eligibility study team members (eight municipal service operators, Provincial technical staff and consultants) as a new eligibility guideline was deliberated upon. It was evident that the development of a guideline which would fully address the needs, problems and interests of the funding agencies, operators and users will be very difficult to achieve. The issue of defining a satisfactory guideline remains under review in Ontario.

The Province of Ontario, as a senior funding agency, has chosen to follow certain practices with regard to eligibility guidelines:

Role of Senior Level

The Province has chosen to establish a Province-wide eligibility guideline. Given the alternative of allowing each local municipality to establish its own guideline, it was

determined that the Province could best assure its objectives of providing the means of basic mobility for those persons defined in the intended user group by establishing an overall guideline. In this way subsidy would be targeted to intended users, the issue of reciprocity could be addressed, and a fair and equitable distribution of subsidy would be better assured. Planning and management of the specialized program would be easier and the extent to which the Province would be prepared to support modifications for improved accessibility to conventional facilities would be easier to demonstrate.

Flexibility at Local Level

As the senior funding agency, the Province recognizes that there is a definite need for flexibility at the local level to ensure that variations in transportation demands and municipal priorities can be accommodated. As a result, the actual interpretation and application of the Provincial guideline, as with other system operating policies, remains a local responsibility.

The 1985 review of eligibility practices in Ontario determined that municipalities were indeed responding to their individual environments.[3] The majority of systems have adopted criteria which, while maintaining the spirit of guideline, have been tailored as appropriate to local conditions. The municipal extension of eligibility was found to be "practical, workable and compassionate,"[4] and in keeping with local needs and priorities.

Scope of Eligibility Guidelines

The Provincial eligibility guideline in Ontario states that services are intended for "those persons, regardless of age, who are unable to board regular transit facilities". Unable to board means unable to climb up the steps of a regular transit vehicle. The rationale for this guideline is:

> If conventional transit facilities were to be made fully accessible people would still have to get to the bus stop, therefore the emphasis is on boarding only.

This guideline provides a relatively stringent basis for eligibility. However, this criteria was deemed to be a reasonable guideline to ensure that those persons most in need of specialized transit facilities would indeed have a public transportation service which addressed their mobility needs and would be assured of a relatively high level of service. Important as well is the fact that this is a functional

guideline which is intended to ensure that services are provided to anyone who cannot perform the function of boarding a transit vehicle for whatever reason. Therefore, many elderly people may have functional restrictions which would make them eligible for the services although they would not be eligible solely by virtue of their age.

It was recognized that a broader interpretation of eligibility would indeed benefit many people who are able to use regular transit facilities only with extreme difficulty. This broader interpretation, although desirable in many respects, creates the problem that service levels for those people most in need of specialized vehicles would be diminished unless, of course, there are unlimited funds available.

CONCLUSION

Eligibility remains one of the most controversial and yet crucial aspects of providing parallel transportation services for disabled persons. The Ontario experience certainly is not unique in the extent of pressures on funding agencies and operators to expand, or alter, or "make just this one exception" to the eligibility guideline. Yet eligibility is critical if services are to be provided in the most effective manner to those who need them most.

For the specialized transportation services, the eligibility guideline is in fact the primary service standard. Because the service is varied and may be a fairly complex range of modes, it is essential to have a means by which the passenger can be assured the most effective service to meet his/her specialized transportation need will be made available. However, from the perspective of both the funding agency and the operator, the service must not only be the most appropriate, but also must be cost efficient.

Eligibility guidelines provide the means by which passenger need is linked with service supply. Guidelines should not be considered a restriction on service, rather they are an assurance that there will be a service supplied which is appropriate to the need. Eligibility guidelines are the guarantee of service type. Eligibility is truly the "ticket to ride."

FOOTNOTES

1 James F. Hickling Management Consultants Ltd., Eligibility Under the Specialized Transportation Program for Disabled Persons - Technical Report, prepared for the Ontario Ministry of Transportation and Communications, August, 1985. The analysis of costs is contained in background work to the report.

2 Op. Cit.

3 Op. Cit.

4 Op. Cit.

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ELIGIBILITY AND RECIPROCITY

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ELIGIBILITY AND RECIPROCITY

WHAT IS COPOH? - COPOH is a cross disability national umbrella organization for self-representation. COPOH believes that disabled Canadians should have the right and responsibility to represent their needs and concerns in all areas of our society. COPOH is an organization OF not FOR disabled persons. COPOH provides a consumer perspective on issues affecting the lives of Canadians with disabilities.

TRANSPORTATION AND DISABLED CITIZENS

Transportation plays a very important role in the lives of all people. However, it is often given very little thought until transportation services become unavailable due to strike, inclement weather or some other extraordinary service interruption. This is not the case if you are a person with a disability; travel for disabled persons can often be fraught with uncertainty.

For disabled persons securing accessible transportation can be much more difficult than it is for non-disabled travellers. Taking a bus to a city mall for a day's shopping may require much advanced planning and scheduling. When travelling by plane one's self-reliance may be questioned. Take for example what happened to one woman flying to a business meeting. "Ruth Adelia, a secretary, says she was 'humiliated' and 'degraded' when Air Canada personnel told her she could not fly because she was non-ambulatory. "I have been flying since 1953 and this has never happened to me before" Ms. Adelia said. On her way to Ottawa... she was told after getting on the plane that she could not stay on board."1 As is apparent from these examples, disabled persons face numerous obstacles when traveling. A Canadian study attributes these problems to "...sometimes misunderstood, often conflicting, objectives and conceptions of social integration, personal independence, human rights, and efficiency of service."2 These will be explored in this presentation.

Despite the situation which exists, the fact remains that accessible transportation is essential if disabled persons are to lead independent lifestyles. As Ron Kanary stated at the 1985 COPOH Conference, "Transportation remains a crucial issue for disabled persons. Without accessible transportation other advancements... become meaningless. If I cannot travel from my home to a place of employment, what good will affirmative action programs do me? I ask you what is more vital to the achievement of equality and full participation than accessible transportation. I submit to you that nothing is more crucial."3 In "Transportation: Key to IL" Frank Bowe elucidates how transportation is a key component of independent living. "Without means of transportation to educational, vocational, cultural and commercial facilities in the community, it is virtually

impossible for most severely disabled people to live outside an institution. In this sense, transportation is the hub of independent living. Its availability expands the alternatives from which a disabled individual can design his or her life... Yet transportation is a spoke in the independent living wheel, too, because it both reflects and sustains the very philosophy of living 'in' the community, providing the handicapped with the same services and facilities accessible to others, allowing the handicapped to pay neither more nor less than they do, and requiring neither obeisance to others or dependence upon them?"4

TRANSPORTATION AND COPOH

Throughout its history COPOH has worked to ensure that citizens with disabilities have equitable transportation opportunities. COPOH has a large body of transportation policy. By participating in the Fourth International Conference on Transport of Disabled and Elderly Persons, COPOH is ensuring that the voice of disabled citizens is heard on some very crucial transportation issues. This presentation provides the consumer view on eligibility and reciprocity. Though it will concentrate on the area of urban mass transportation, it will also touch on issues relevant to other modes. This presentation is built on a foundation of citizenship rights- an approach still not understood universally.

MERIT vs RIGHT - The pre-conference material distributed to presenters posed the question "WHO SHOULD QUALIFY FOR MERIT TREATMENT IN TRANSPORTATION? Webster's Dictionary defines merit as "the state ... of deserving". The conceptualization of the issue in these terms presents transportation for disabled persons as a charity or special service which will be awarded to the "most deserving disabled people". Logically the next step is then to define WHO is most deserving. Consumers do not frame access issues in these terms.

Persons with disabilities speak as citizens in terms of rights. We formulate our issues along these lines. We do not request particular services because we are " deserving". Transportation is not an issue of "local compassion" as the pre-conference material suggests. Access to Canadian transportation services is a right that has been guaranteed to disabled citizens in Canadian legislation, policy statements and by regulatory bodies. Consequently, there is no need for disabled persons to speak in such terms as merit or local compassion. Important Canadian milestones on the road to accessible transportation are presented in the next section to support this position.

This presentation deals with issues of concern in Canada and elsewhere. As David Baker has stated "It appears unlikely that the efforts of equality-seeking disabled Canadians are likely to be confined by anything so arbitrary as national boundaries..."5 These comments are very true. Canadian consumers have begun

looking beyond Canadian transportation systems. We want to travel outside our own country. We too want to visit Times Square, the Eiffel Tower, the Pyramids, and countless other destinations. To make this possible various accessible transportation options are essential for all countries. Access to usable ground transportation is as necessary as accessible air transportation if disabled persons are to have the freedom to move from country to country. Universally accepted standards and procedures are required.

While travel within Canada has improved for disabled citizens this is not the case everywhere. Canadian consumers have taken action to improve this situation and passed the following resolution in 1984. "WHEREAS transportation issues have an international scope. BE IT RESOLVED that COPOH encourage the North American Regional Assembly of DPI to establish the whole area of transportation...as one of their priority issues.... A Canadian, Claude Laforce, now co-chairs the North American Region's Transportation Committee which was established in July 1985.

THE CANADIAN SCENE

In Canada many important milestones have been passed on the road to accessible transportation.

THE MAGNA CARTA - The Canadian Transport Commission (CTC) decision in the Clarris Kelly case stands as a significant milestone on the road to accessible transportation services in Canada. VIA Rail denied Kelly transport because she was not travelling with an attendant. CTC ruled in her favor establishing four principles: self-determination; one person/one fare; equality of access; and dignity of risk. Canadian lawyer David Baker has referred to the Kelly decision as the "Magna Carta of disabled persons' rights in Canada."6

ACCESSIBLE INTER-CITY BUS TRANSPORTATION - Another important milestone is Newfoundland's Roadcruiser project. In Newfoundland VIA operates an accessible inter-city bus providing service to disabled and non-disabled passengers. This project demonstrates that accessible inter-city buses are a viable transportation option. A demonstration project, conducted by Transport Canada, illustrates this point even further. These projects suggest that it is not a lack of design options which is impeding the introduction of accessible buses into Canadian transportation systems.

A NATIONAL TRANSPORTATION POLICY - Another important milestone is the National Policy on Transportation of Disabled Persons which came into affect in 1983. The policy guarantees for disabled persons: REASONABLE, RELIABLE, AND EQUITABLE TRANSPORTATION SERVICES AND FACILITIES; DIGNIFIED TRAVEL; NO UNREASONABLE TERMS AND CONDITIONS OF TRAVEL; and SELF-DETERMINATION.7 Most

importantly the policy establishes equitable access to transportation through the removal of environmental obstacles as its goal. In the Policy, cost is not recognized as a justification for carriers not providing access. COPOH fully supports these principles.

LEGISLATIVE PROTECTION - The *Charter of Rights and Freedoms* guarantees disabled persons equal protection before and under the law. In 1983 the *Canadian Human Rights Act* was amended to extend the grounds of protection to physically and mentally disabled persons in access to facilities and services.

THE BUS MODE

Despite the numerous transportation advancements which have been made in Canada, generally speaking the bus mode lags far behind the rest. This is true of both inter-city and urban bus transportation. It seems that the Canadian bus industry has been fearful that onerous accessibility requirements would be placed upon it. Much of this fear was fostered by events that happened south of the border. This was recognized in COPOH's 6th CONFERENCE REPORT. "In the United States disabled persons formed strong lobby groups, pressed for, and won access to existing urban transportation systems. Urban transportation authorities, together with the bus manufacturing industry, resisted these attempts. Much of the American transportation industry's reactionary attitude found its way across the U.S./Canada border and continues to manifest itself in the attitudes of Canadian urban transit authorities. While Canada has a remarkably good record in terms of establishing parallel transit services it has failed to introduce in any meaningful way accessible urban mass transit systems."8 Disabled citizens have recognized these feelings and have attempted to put them to rest. Canadians with disabilities are reasonable people and do not want to place unreasonable demands on any service provider.

The bus industry's attitude toward accessibility is indicated in the Canadian Urban Transit Associaton's (CUTA) 1980 Policy Statement on Transportation of Disabled Persons."CUTA cannot recommend the approach of modifying existing transit systems to accommodate wheelchairs; it would be by far the most expensive solution and would probably provide lower accessibility than other options."9 CUTA substantiated its positions with references to positions taken by the American Public Transit Association (APTA) and the International Union of Public Transport (IUPT). "APTA believes that mandatory accessibility on regular transit routes would fail to be cost effective, and would not provide the sought after mobility". IUPT stated: "... the disabled (especially severely disabled persons confined to wheelchairs) should not be carried by the ordinary public transit system."10 The statements contained in

the CUTA paper, seem to imply that transportation for persons with disabilities is not really a mass transit or public transit issue.

A MASS TRANSIT ISSUE

The argument that accessible transportation is not a mass transit issue is a smoke screen. There are frequent attempts to define accessible transportation as a social issue. Moakley and Weisman in their article "Cost: Is The Price of Accessible Mass Transit Too High?", explain that:

> With few exceptions, transit agency personnel cling to the notion that accessible public transit is a **social** issue, and not a mass transit issue. Their view is that their responsibility is to provide transit for the masses; so let social service agencies provide transit for the disabled. Their view is that their industry is being victimized, that a so-called complex social problem - mainstreaming the disabled - is being heaped **entirely** upon their shoulders.11

This is not an uncommon view of disabled persons' issues.

For many years disabled persons have been battling to have our issues recognized for what they are. Initially our issues were viewed as "medical problems" due to an over-reliance on the medical model. In recent years this has altered somewhat. Now there is a tendency to define all our concerns as "social problems." It is the objective of the consumer movement to have disabled persons' issues addressed by appropriate agencies and government departments. For example, income security problems should be dealt with by economic ministries and uneyployment should be dealt with by employment agencies, etc.. COPOH seeks to ensure that services for citizens with disabilities are provided by mainstream service delivery systems.

URBAN TRANSPORTATION

Throughout the world urban transportation is provided to disabled persons by a variety of mechanisms. These range from "specially made cars in Germany to full access on transit vehicles in several U.S. cities; from full access in conventional taxis in Australia to special transit services in Sweden". 12 Despite this range of options Canada has tended to follow only the parallel service option.

Discussions on urban transportation for disabled persons tend to become polarized around two options - fully accessible fixed - route public transit services and parallel transit alternative. Tait, in her paper prepared for the Third International Conference on Mobility and Transport, indicates that this

polarization has occurred in other countries as well.13 It has been suggested that this polarization has arisen due to a limited understanding of available options; the nature and extent of the population in need, and the fear of unreasonable costs associated with accessible transportation.14

Despite agonized debate over integrated vs parallel transit, neither is the complete solution to achieving accessible transportation for disabled persons. This is due to the fact that neither on its own can achieve an equalization of opportunities for disabled persons. The World Program of Action defines equalization of opportunities as the "process through which the general system of society... is made accessible to all."15 To achieve this some combination of both options, augmented by perhaps other solutions as well, is required. Tait concurs that some blend of integrated and separate services would best serve the transportation needs of disabled persons.16

Consumers have indicated satisfaction in areas where integrated systems have been introduced. Moakley reports;, "No American city has a completely accessible mass transit system. Perhaps Seattle is the closest to this, and interestingly, the accessible mass transit service in the city has enjoyed wide acceptance and high ridership among disabled residents".17 Moakley's comments are reiterated by Seattle resident Martin Weisman who states, "Our mass transit system is 90% accessible, and June figures showed 2000 riders per month on lift buses (one-way riders). In Seattle the disabled are using the buses and trolleys."18

The inadequacy of an either/or approach was recognized by delegates who attended COPOH's 1985 Transportation Conference. Knowledge of what has happened in other countries, led them to pass the following resolution which calls for an amalgamation of both approaches.

> **WHEREAS** neither a parallel nor an accessible municipal bus system will adequately meet all disabled persons' transportation needs i.e.:
>
> - A parallel systems is inadequate because:
>   1) the cost necessarily rises as ridership increases making it too expensive to meet the need;
>   2) it is a segregated system.
> - Accessible buses without a parallel component are inadequate because some disabled persons cannot use them.
> - Unable to get to a bus stop.
> - Unable to wait at a bus stop.
> - Unable to ride on the bus because ride is too rough.
> - Unable to understand instructions.
>
> **WHEREAS** only an integrated system with para-transit and accessible buses can transport all disabled people and

still be affordable (cost per ride decreases as ridership increases on accessible metro buses).

BE IT RESOLVED that COPOH endorse integrated transit systems where feasible and appropriate and strongly encourage the federal government to assist provinces, territories and municipalities in Canada implement such systems through:

1) dissemination of information;
2) long term financial incentives including exemptions from federal tax of <u>all</u> accessible transit including metro buses.

COPOH continues this call for integrated urban transit systems.

It should be noted here that consumers in their quest for accessible transportation are not seeking "equality of service". Rather the consumer goal is to achieve "comparable service". Comparable service entails eight basic elements. 1. Comparable service must be provided throughout the same general service area as the public system. 2. Comparable fares should be charged on public and parallel systems. 3. Hours of service must be the same for both systems. 4. Attendants must travel on the disabled passenger's ticket as they are providing a vital service for the traveller. 5. Systems must have sufficient vehicles to avoid priority listings or restrictions on trips. 6. There must be comparable waiting times. 7. Waiting lists must be eliminated so that all eligible users are served by some form of public transportation. 8. True reciprocity must exist so that disabled persons can ride systems available in any city.19

<u>ELIGIBILITY CRITERIA</u> - You may ask, "Well what does exist in Canada?" CUTA reports that since 1981 the number of communities which provide transportation for disabled persons has dramatically increased. There are 330 transit systems for disabled persons in Canada.20 It is also expected that 15 additional systems will be in operation in the near future. What does this mean for citizens with disabilities? A great deal depends on where the person lives as these systems have different eligibility criteria. These are summarized in the following table,

TABLE 1 21

Province	Eligibility Criteria
AB (1985)	Most systems are for "adults who would have difficulty using regular transit." Small communities may serve broader categories, all ages and handicaps.
BC (1985)	To assist persons who cannot <u>use</u> conventional services without assistance. Includes all ages,

	incomes and mental handicapes.
MB (1985)	By Municipality. Eligible users are the physically handicapped who cannot use public transit.22 rural areas served.
NB (1985)	Funding and service policies are the responsibility of the local municipalities.
NF	Those persons who have difficulty using conventional transit due to a disability.
NS (1985)	All handicapped persons.
ON (1979)	Any municipality, regardless of whether they have existing public transit. Definition of user is physically disabled person who is unable to board regular transit facilities. No age, income limitation. Includes mentally handicapped who meet definition.
PEI	By municipality.
PQ (1983)	Eligibility committee with municipal and user advocate representatives. Definition based on ability to use conventional transit with dignity.
SK (1985)	Municipalities define eligibility. Generally: "To assist all persons who cannot use conventional transit systems with dignity.
YK	"Unable to use conventional transit includes physically and mentally handicapped.

It is obvious from Table 1 that eligibility criteria can operate to exclude citizens who may require specialized transportation services. In Ontario a user is defined as a physically disabled person who is unable to board regular transit facilities. The definition's narrowness excludes many potential users. Take for example a person with a stamina problem. Such an individual may be able to board a regular bus but may not be able to endure long waits at bus stops or stand throughout a bus trip. The Manitoba eligibility criteria limits service to physically disabled persons. Mentally and developmentally disabled persons may also require access to a specialized service.

Eligibility is usually controlled by local registration procedures.22 In 1981, 86 per cent of the systems in operation utilized registration requirements to control ridership23. Some systems require a user's doctor to participate in the registration procedure.

Numerous factors determine eligibility criteria. Criteria are partly a product of provincial funding policies.24 Conditions at the local level also play a role in determining eligibility criteria. CUTA explains this phenomenon in the following manner.:

> Local communities often put their own interpretations on eligibility criteria. Generally, the larger cities adhere more strictly to provincial guidelines. Because of the substantial costs of providing special transit service, some of the large cities, such as Edmonton for example, have more restrictive eligibility criteria than the province requires. With the exception of British Columbia, where the level of service is defined by a contract with BC transit, a local community is free to exceed provincial eligibility guidelines providing the community pays any incremental deficit incurred. In practice, this rarely happens because of the substantial cost and the difficulty of disagregating the costs.25

What this means is that eligibility criteria are used to regulate supply and demand. Narrow criteria restrain demand. In a 1981 article entitled "A Personal Look Backward at the Accessible Mass Transit Issue" Terry Moakley describes the impact that such policies have in personal terms. Moakley writes,

> While the transit authority in my city has been reporting "special efforts paratransit services to UMTA since 1976, I have never been able to actually use any of these paratransit services to commute to and from my job, because all paratransit services in my city have restrictions built in. I am not a client of United Cerebral Palsy, so I cannot use their van system. I do not travel in off-peak hours, so I cannot use the American Red Cross vans. I do not live on the lower east side of Manhattan, so I cannot use the Easyride van system. And so and on...26

Moakley cannot utilize transit services in his city because he falls between the cracks created by restrictive eligibility requirements. His reduced transportation options serve to limit the choices available to him.

A case example will serve to illustrate the negative impact which restrictive criteria can have. The Manitoba League of the Physically Handicapped (MLPH), a COPOH member group, reports on the situation which exists in Winnipeg. "Handi-Transit currently operates under a priority system in which individuals requiring rides for work or school are given preference over... needs for other purposes. The existence of this priority system clearly indicates that present services are inadequate...The principle of providing low cost transportation, which is comparable in quality and quantity to services enjoyed by the general public is being violated".27 Shopping, banking, volunteer work are essential to

the mental and physical health of any individual and attempts to priorize essential services reflect an unacceptable situation in which transportation resources are insufficient to meet essential needs. These needs are taken as essential for the general population and resources are provided to meet them.28

In such a situation supply dictates a new eligibility criteria - type of trip. The individual who is not working or who is not going to school becomes less eligible for service. This is in sharp contrast to the "official" eligibility provision which lists all physically disabled persons as being eligible. It says nothing about what "type of trip".

In the particular situation described in the 1983 report MLPH attributed this situation to fact that the Handi-Transit system operated too few specialized vehicles. At that time Winnipeg had 13 specialized buses. A Federal Government study indicated that Winnipeg's population warranted 16 buses.29 A 1984 follow-up report indicated no improvement. Recent interviews with system users indicate little change.30 This case example indicates that all is not well with para-transit as it operates in Canadian cities.

This situation would not be a surprise to anyone who has studied the issue. Tait makes the following comments about the parallel option:

> States opt for "separate but equal" transportation services which often turn out to be considerably less than equal. Separate, parallel, door-to-door services may appear to be less costly in the short term but, as trip demand increases, experience shows their efficiency and response levels begin to drop." Eligibility criteria are often narrowed to restrain demand which only frustrates potential users.31

Equity requires that parallel services be made comparable with public transit services. Tait surmises that , "In the long run, separate services are likely to remain unequal and pressure will continue for integration in urban transportation services."32

RECIPROCITY - CUTA reports that reciprocal user arrangements are becoming common even though eligibility criteria may vary from community to community.33 Consumers have passed the following resolution on the topic of reciprocacy.

> WHEREAS non-handicapped individuals who travel are eligible to use regular transit in any city they are visiting regardless of their original city residence;
>
> THEREFORE BE IT RESOLVED that COPOH and its provincial affiliates take steps, in conjunction with local handicapped transit operators, to ensure that the handicapped travellers can use parallel public transit in cities they are visiting.

COPOH continues to uphold this position. The current situation which exists with narrow eligibility criteria and restrictions on trips makes reciprocity rather meaningless in reality. Theoretically a person may be able to use a system in another city but priorized trips and waiting lists would reduce the likelihood of their actually getting a ride.

AIR TRAVEL

As Cinnie Noble in Handi-Traveler points out, "It is air transportation that has made the world small; changes in culture, language and climate are only hours away."34 Many difficulties still exist in the area of air travel for disabled persons. One persistent problem is that "the rules" which apply to disabled persons tend to vary from carrier to carrier. The interpretation of these "rules" is another matter as well. The Ruth Adelia case is an illustration of this.

In April of 1984 Air Canada initiated reduced fares for attendants travelling with disabled passengers. Attendants now travel for half price on all Air Canada's North American (Canada and transborder U.S.) regular priced fares. C.P. Air, Quebecair, Nordair Pacific Western, and Eastern Provincial offer this half price fare only within Canada.35 COPOH advocates that an attendant should travel on the disabled passenger's ticket.

Eligibility is determined on an individual basis. Medical clearance is mandatory when an attendant is requested. This involves approval of the attendant by the passenger's doctor. As Noble indicates out there are no universally established procedures for medical clearance. The International Air Transportation Association, however, has suggested a format for member air lines. A disabled passenger who is travelling on several airlines must meet the requirements of each not just the original carrier. This can create obvious difficulties. Universally accepted procedures are a necessity.

ELIGIBILITY CRITERIA VS SELF-DETERMINATION - COPOH strongly supports the concept of self-determination. The disabled traveller him or herself should be able to determine what travelling options are required. The disabled consumer, not a doctor should determine whether or not an attendant is necessary. The disabled person is best able to assess what measures are required to accommodate his/her disability. In the same way, consumers should also be the ones who decide whether or not they need to travel on para-transit systems, on accessible integrated systems or on the "regular" bus system.

The usual argument that is used to counter the self-determination position is that systems will be abused by persons who do not really require these access provisions. Such arguments are short sighted. Potential abuse is frequently used to counter the one

person/one fare concept. Travelling with an attendant is an expensive proposition. Even if the attendant travels on the disabled travellers ticket, there are still many extra expenses incurred - meals, accommodations, salaries, etc. The extra cost involved will mitigate the unwarranted use of attendants. Urban para-transit systems tend to be so inconvenient to travel on that only those without other alternatives would select them. Most people like to travel the easiest way possible not the most difficult. Disabled consumers in Canada wholeheartedly uphold the concept of self- determination.

CONCLUSION

Accessible transportation is a right that has been guaranteed to citizens with disabilities by Canadian contitutional and human rights legislation. Consequently discussions on service provision must be built on a rights foundation. Equity requires that disabled travellers have access to transportation services comparable to what the general public enjoys. For this to happen eligibility criteria must become less restrictive and reciprocity must become a reality in Canada. Disabled persons expect when travelling to find what is guaranteed by the National Policy on Transportation of Disabled Persons - reasonable, reliable and equitable transportation services and facilities, dignified travel, no unreasonable terms and conditions of travel and self determination. COPOH will continue to work to insure the removal of obstacles to accessible transportation.

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ELIGIBILITY AND RECIPROCITY

LOCAL COMPASSION VERSUS RESOURCE CONSTRAINTS AND FUNDING AGENCY REQUIREMENTS FOR PARA TRANSPORTATION SYSTEMS

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Eligibility and Reciprocity

In what follows, I intend to argue for the broadest possible interpretation of user eligibility and reciprocity criteria for paratransit services. This apparently "compassionate" stance is, it will be shown, the single most cost-effective device for upholding the rights - and that word should be emphasized - of the transportation handicapped, given existing financial constraints.

Freedom of mobility, as the prerequisite to participation in society, is among the most basic of human rights. It is guaranteed by the United Nations Charter, by the Helsinki accords, and by Section 6 of the Canadian Charter of Rights and Freedoms. Regrettably, all of these guarantees were framed by legislators who apparently conceived their task as involving the simple removal of legal barriers to unhindered movement; they seemed not to have imagined a citizen who was not "healthy" and "normal." But there are those to whom access to transit facilities is impeded by physical or mental disabilities, by an inability to pay for whatever suitable transportation does exist, or by the sheer absence of services which could accommodate their needs. These are the "transportation handicapped"[1] (or "TH"), those who suffer a denial of a basic right. Obviously, this definition includes, but is not limited to, the mobility impaired.

Interest in this issue, fueled in part by the UN's proclamation of the International Year of Disabled Persons, has been growing for some time. In Canada, the National Transportation Act (Section 3) provides for "accessibility" and "equity" in federal jurisdictions.[2] The Canadian Human Rights Act provides for "access to goods, services, facilities and accommodations" for the handicapped, and prohibits discrimination on the basis of disability alone.[3] And Section 15 (1) of the Charter states that "Every individual . . . has the right to the equal protection and equal benefit of the law without discrimination and, in particular, without discrimination based on . . . age or mental or physical disability." Subsection (2) of the same section goes on to except what is commonly known as "affirmative action" from the definition of discrimination; thus, special transit systems are explicitly within the terms of the Charter.

Without denigrating the compassion or concern for justice of lawmakers and executives, we can imagine several other economic and political forces at work in promoting the cause of disabled persons. The first of these is the growth of the aged -- disproportionately poor and disabled[4] -- as a lobby group in the "greying society" of the developed world. Thus, the three countries (Sweden, Japan, and the United States) with among the world's largest aged populations are also the three which are, arguably, devoting the most resources to accommodating the transportation handicapped. In Canada, the number of the

population over 65 is expected to double every generation until around 2020; the increase in transportation handicapped will be 67% - twice the overall population increase - by the turn of the century.[5] We may reasonably infer from this that political pressures from the TH will continue to be felt.

Secondly, and on the other hand, there is the long-term cost-efficiencies to the health-care system implied by the movement toward "de-institutionalization" and "mainstreaming" of the disabled. With ever-fewer employed or employable persons supporting a system devoted to growing numbers of aged or "dependent" persons (in the demographer's sense of the term), it becomes increasingly necessary to get "more bang for the medical buck." This can be achieved by minimizing the numbers of those in chronic-care wards, homes for the mentally retarded, nursing homes and other institutions. This, in turn, requires a system to transport the "mainstreamed" to outpatient facilities; hence, the current growth of the popular "day hospital" programs.

The third point is related to the second: "mainstreamed" individuals are not only less of a drain on the health care system, but on other social services as well. If it is at all possible for a disabled person to earn income, then this increases - however slightly - national productivity, and reduces state support in proportion. Those who have a job do not need welfare. Again, this presupposes a system to get the disabled worker to and from work. In a world of government retrenchment then, provisions for the transport of the handicapped make sense.[6]

All of this would seem obvious, and a potent weapon for advocates of mobility rights for the handicapped, yet there seems to be no cost-benefit analyses available for Canada of these factors. Such an analysis should be a priority.

Further, the right of the impaired to integration in society is closely tied with the right to life: gerontologists have found that those who participate to the fullest extent possible in social affairs, both work-related and otherwise, are less subject to depression, and longer-lived.

For all these reasons, Ohta's[7] statement about Japan: "viewed from the standpoint of the transportation disadvantaged in the broadest sense, the goal of policy becomes to overcome physical and economic restrictions on mobility and to guarantee freedom of movement by improving existing transport systems or by adding new transport services (or both)" applies a fortiori to Canada. The question then becomes, as Tait and Allen wistfully ask, "How much is enough?"[8] What level of service provides "equity?" Is the object, indeed, service alone or integration of the handicapped into "regular" transit? Should transportation provide access to other social institutions, or is access to the transportation itself at issue? And who pays?

In the United States, Congress has declared that "elderly and handicapped persons have the same right as other persons to utilize mass transportation facilities and services; that special efforts shall be made in planning and design of mass transportation facilities and services" to ensure accessibility.[9] This coincided with a thousand-fold increase in federal funding for mass transit, so that the declaration was quite influential. Clearly, then, the United States has opted for a particular definition of equity which stresses integration into the public transit network. The use of special transportation, otherwise called "parallel" or simply "paratransit," was to be an interim measure only; and this orientation has been reinforced by a recent court decision.[10]

That approach has two apparent advantages: mainstreaming seems to be enhanced, and segration reduced. But it calls for extensive retrofitting of existing stock, the development of costly and "bug ridden" new technologies,[11] and it still denies service to those who cannot travel from their own door to the bus stop and back. Consequently, the Americans have begun to experiment with other techniques, the most promising of which provides user subsidies to the TH and relies on free market mechanisms to provide services as needed.[12] Japanese communities, likewise, have more-or-less limited their aids to the mobility-handicapped to a reduced-fare system for the elderly.[13]

The Swedes have adopted a different, three-pronged approach. Their Transportation Board has provided for fare-subsidies for any form of transportation (in 1977, handicapped travel accounted for 40% of taxi system revenues);[14] while implementing a sophisticated accessibility programme for new and some existing stock (whether land, air, or water-borne), the whole to be completed by 1992; at the same time, paratransit is provided as a right to those unable to use public transit.[15]

These examples illustrate an important point: successful transportation for the handicapped is enhanced when equity is defined, not primarily as the right to use public transit, but as the right - one way or another - to be mobile. I would suggest that considerable confusion and inefficiency arises from a lack of clarity on this score. However, funding may become less problematic when the costs of handicapped transportation are borne by the public transit system as a whole, with direct subsidies on the basis of financial need.

In Canada, land transportation is a provincial responsibility, with urban transit delegated by most provinces to local jurisdictions.[16] As a result, implementation of what I have identified as a "right" to mobility for the handicapped is spotty, ranging from the rather sweeping provisions - "no exclusions, no favour" mandated in Quebec[17] to the continued reliance on private charity (cost effective, but hardly an

appropriate forum for the redress of civil rights grievances) of Prince Edward Island.[18] In addition, variance between municipalities is so different because 1) several municipalities maintain their own programmes under "grandfather clauses", that is, their system of transportation for the handicapped existed since inception; 2) philosophies of entitlement differ enormously but, above all, 3) because cost factors are paramount.

Cost, contrary to some opinions, is a valid defence for the abridgement of rights under the Charter. The federal government's own Transportation policy (developed in 1983, two years after the Charter became law and, therefore, presumably constitutional) explicitly allows that "one leading consideration must be the cost and practicality of making accessible to disabled persons certain transport vehicles and terminals."[19] And Section 33 of the Charter itself - the "notwithstanding" section - permits provincial legislatures to void any of the relevant provisions of the act, so that it would be very difficult to win a suit alleging discriminatory service in transportation. Consequently, Canadians are, on the whole, spared the dilemma prevailing in the United States where an unworkable policy regarding the TH is the law of the land. Yet, the variations in service which do exist in Canada are inequitable in and of themselves.

The existence of a paratransit system - the basic mechanism for transportation of the disabled throughout Canada - effectively separates out these very high costs from those of the standard public transit system, making them politically contentious. In Hamilton-Wentworth, for instance, the registered TH make up less than one per cent of the total population (far below the five per cent estimated by Statistics Canada -- apparently a large proportion of the TH are not being served by paratransit) but the paratransit bill is six per cent of the public transit's.[20] Yet the fare is the same on both systems. That, combined with elements of greater convenience - door-to-door service - might be construed as reverse discrimination. It should be recalled that, while the savings implied by aid to the TH are likely to be considerable, they are difficult to determine and scattered throughout the national accounts; costs for paratransit, by contrast, are highly visible. And the goal of equity <u>is</u> modified by considerations of cost.

Equity, then, remains at issue. In what remains of this paper, let us consider an "ideal" case, and seek to balance it against the pragmatically possible. We should begin with a few basic assumptions: first, that it is not the right to ride on <u>public</u> transit which is at stake, but the right to get to where one wants to go; the transit system implements a right, but is not itself an object of civil rights. Second, let us assume that the TH, <u>mutatis mutandis</u>, sincerely desire to be treated with dignity as "normal" citizens; to be independent and integrated. Third - and this assumption is at the root of any liberal democracy - let

us stipulate that the individual alone is the best judge of his or her own interests.

Now, if the public transit system is fully integrated, then questions of eligibility and reciprocity do not arise: the facilities for the disabled are simply there, available to whoever believes he or she needs them, including the temporarily disabled such as pregnant women or inebriates. Such integration is possible, to one degree or another: we can consider courtesy seats, the use of verbal announcements of stops on buses and subways (helpful to the visually impaired) and a host of other advances, however modest, at increasing integration. The Toronto Transit Commission is currently looking at a looser route schedule, which will allow more time for the aged and others to board and disembark (although this is not the Commission's main purpose).

More can be done, and should be done, since integrated public transit reduces de facto segregation, provides cross-subsidies for handicapped in the same way that downtown ridership subsidizes suburban and exurban routes (that is, some patrons pay a little more than necessary so as to defray costs to others), and relies on individual assessment of needs.

But -- unless every public transit route someday entails attended door-to-door service -- there will always be a place for paratransit, as the Swedish and American examples, each in their own way, make clear. Paratransit systems of necessity create a new class of person: the "eligible rider," and the temptation always exists to keep costs down by limiting service, by restricting the number or assigning priorities to trips and, above all, by restricting eligibility.

In Ontario, eligibility is limited to those who cannot board public transit, (The Hickling study recommended the word "use" and added - or who cannot walk more than 300 metres unassisted).[21] This means that most of those eligible for paratransit under a strict interpretation of these rules -- and funding usually depends on following them -- are those who are wheelchair-bound: the group of disabled least likely to work or go to school and, therefore, the group whose travel needs are most sporadic.

Yet a large core of regular riders is the most cost-effective component of any transit system, regular, integrated, or parallel.[22] Moreover, given the current state of accessibility of public transit, this interpretation certainly means that some people will "fall between the cracks;" unable to use public transit, unable to afford private transit, and ineligible for paratransit. Is this the intent of such guidelines?

When one sets up eligibility criteria, one in essence questions individual judjment: "you may think you need paratransit, but

we'll decide." Obviously, the purpose is to prevent abuses, but largescale abuse seems unlikely: the TH want integration, and will only seek paratransit when compelled to do so; the mobile are probably too prejudiced to seek the exclusive company of the TH as would be found on paratransit, and most would be ashamed to "steal from cripples."

Further, I would recommend that fares on paratransit be proportionate to fares on public transit (i.e.about 50% of operating costs[23]) rather than absolutely equal as they now are. Instead of funding paratransit services directly, one would subsidize users - mobility impaired or otherwise - on the basis of financial need; for financial need is a social services issue which can and should be distinguished from the right to mobility.

Already, elements of such a subsidization policy exist; indeed, public transit itself is an instrument of policy[24], and it would not be so difficult to provide vouchers or a pass good on <u>any</u> publicly-funded vehicle to those who could demonstrate its necessity. Certainly, the administration of such a programme would be simpler than equitably determining eligibility for paratransit.

It should be reiterated here that the disabled are a low-income group not strictly because of their disabilities, but because of the difficulties a handicap puts in the way of finding and keeping work. To facilitate transportation will not eliminate those difficulties, but - just as the able-bodied unemployed are supplied with free bus passes in some cities so as to help them seek work - it will reduce them. User-side subsidies are, therefore, a wise investment, as the American experience has shown.[25] Indeed, they would reduce hardship not alone for the disabled, but for any TH person. Further, they would permit the individual, and the individual alone, to match his or her needs to the most appropriate form of transportation, unhindered by official interference.

These are radical propositions, I suspect, and not likely to be implemented in the near future. But they do provide indications of how we may contend with the world as it is. The first priority must be to move as many of the TH as possible, as expeditiously as possible. This will require action on several fronts:

<u>Long-term Recommendations:</u>

1) The design of a thorough, socially-informed cost-benefit analysis of the long-term savings to be expected from fuller integration of the TH. The analysis might consider several scenarios, ranging from the status quo to full integration, and should be collectively supported.

2) Armed with this data, and allied perhaps with advocacy

groups, a determined lobbying effort at the federal, provincial and local levels to awaken regular public transit to the need for boarding and rider aids for the disabled. This should be combined with efforts to secure from governments a promise to protect the transit system's bottom line from the impact of costs associated with aid to the disabled.

3) Negotiations by paratransit operators with those governments supporting an exclusionary definition of eligibility to reformulate eligibility criteria.

Near-term Recommendations:

1) To facilitate reciprocity, our first priority should be to have at least one interurban bus or train fully accessible to the disabled, this to run on local round-trips at least once a week. A proposed route using Hamilton as a hub is attached (Figure 1).

2) Operators themselves should seek to arrive at a single, province-wide operating definition of eligibility, one as broad as possible so as to accommodate maximum numbers of TH, and fully costed as well. We should repeat as often as necessary to policymakers that the TH have rights as citizens, and that, therefore, these rights should not vary in implementation from one place to another.

3) Municipalities should seek to make their systems as truly "parallel" as possible, by lengthening days and hours of service to match regular transit, by reducing lead-times for reservations and by eliminating priorities and waiting lists.

4) In the absence of government funding for these expanded services, operators should seek aid directly from the community - not neglecting groups representing the disabled - on a local initiative, self-help basis. Possibly those who do not qualify for paratransit under provincial guidelines should pay a fare more in keeping with actual operating costs. This *fait accompli* would, hopefully, put pressure on legislators to remove so obvious an inequity by broadening eligibility criteria.

A generous "compassionate" definition of eligibility and reciprocity is a viable option, cost-effective in the long run, and an absolute necessity unless and until a more integrated transportation network becomes a reality. It is something paratransit operators can do in the absence of initiatives from government or from regular transit, to fulfill their mandate and to further the cause of simple justice.

NOTES

1. According to the World Health Organization (cited in Office des personnes handicapées du Quebec, OHQ n.d: pp 16 ff), an impairment is an observable, diagnosable pathology whether physical, mental or psychological. A disability is a reduced capacity for "normal" human activity, resulting from an impairmant. A handicap is a social disadvantage stemming from an impairment or disability. Sociologists such as Erving Goffman have used the term "stigma" instead of handicap, to stress the social identification of the individual as "sick", "abnormal", somehow less than human.

2. Transport Canada, 1983:p.4

3. Tait & Allen, 1980:p.10

4. For Canada, see Statistics Canada, 1985. Tables 7 & 5.

5. See Ohta, 1984; Tait and Allen, 1980:pp.14ff,

6. For a review, see Marshall, 1984; see also OHQ; n.d: pp.1-2

7. Ohta, 1984:p.96

8. Tait and Allen, 1980:p.27

9. Quoted in Cass, in CRCD 1978:p.158

10. In Main Association of Handicapped Persons vs. City of South Portland, August 13, 1984, Superior Court Judge Donald Alexander ruled that a paratransit system was segregationist in effect and contrary to state law.

11. Cass, in CRCD, 1978:pp.159ff.

12. Spears, 1982:pp.13-17

13. Ohta, 1984

14. Tait & Allen, 1982:p.14

15. Swedish Board of Transport, 1982; Tait & Allen, 1982:p.14

16. Tait & Allen, 1982

17. OHQ, n.d:p.3

18. CRCD, 1978:pp.7-9

19. Transport Canada, 1983:p.14

20. Calculated from CUTA, 1984; DARTS' Annual Report, 1984

21. Hickling, 1985

22. Starks, 1982

23. CUTA, 1986;p.19

24. CUTA, 1986:pp.2ff

25. Spear, 1982; Reilly, 1978; Kirby and Yolson, 1976

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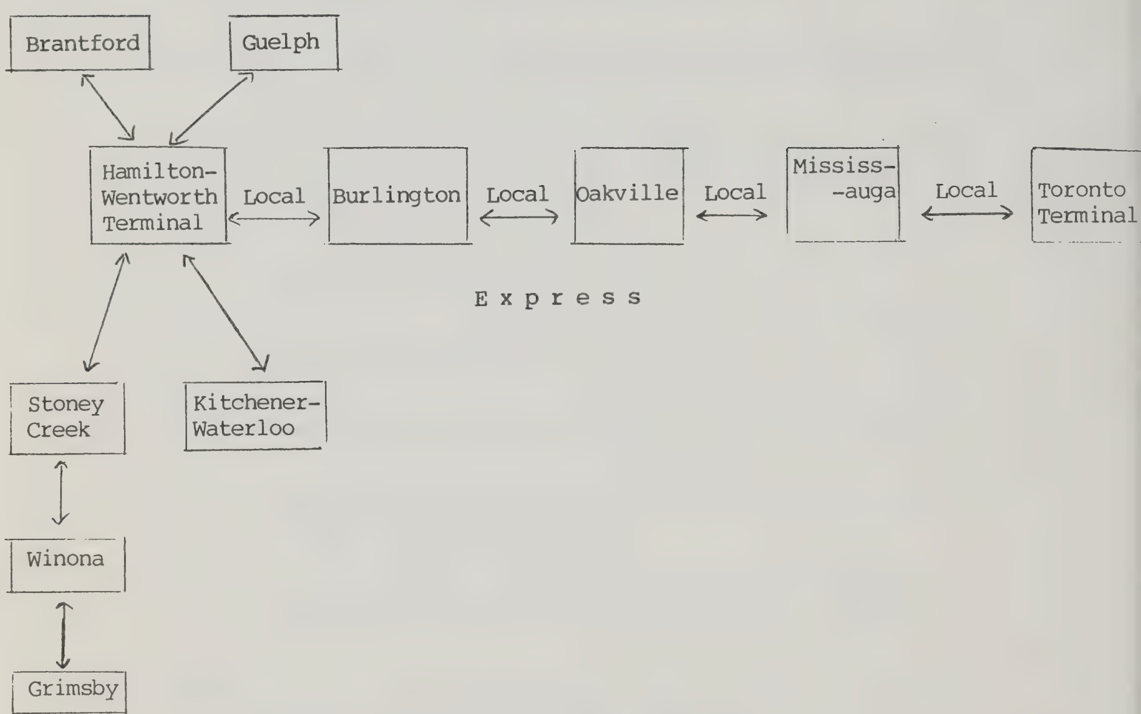
Figure 1.

DIAGRAM SHOWING RECIPROCITY ATTAINABLE THROUGH AN INTEGRATED SYSTEM WHICH COMPLIMENTS EXISTING PARALLEL SYSTEMS



KINGSTON BUS
FOR THE HANDICAPPED

Jack Colley
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July 22, 1986.

The transportation system for the Physically Handicapped person in Kingston, Ontario was started as a Centennial Year project in 1967.

At an organizational meeting made up of interested members of the Multiple Sclerosis Society, the Cerebral Palsy Association, the Arthritic Society, the Rotary Club, and the community at large, a five member fund raising committee was formed. Its mandate was to raise $10,000. In six months not only had this hard working committee reached its goal but had surpassed its target by 10%! With $11,000 in hand the purchase of a bus to transport the handicapped was now an attainable goal. A check of the bus distributors supported this thinking and in 1967, a Chev bus, our number one vehicle at a cost of $8,000 became a reality. This price included wheelchair clamps, sufficient to fasten nine wheelchair passengers, 14 seats for semi-ambulatory persons and a hydraulic lift for easy access by wheelchair users!

One has to give a special note of thanks to our city's firemen who, on their off duty hours, took a very special interest in this project and provided volunteer drivers, board members and service personel to keep the vehicle in repair. Although our first paid driver appeared on the scene in 1971 and a second vehicle, a van, was purchased, the firemen continued their volunteer work with Kingston Bus for the Handicapped until 1976. The system was expanding quickly, beyond the available time our volunteer drivers were able to provide and as a result, a new Board and a more business-like approach was sought. The first item on this new Boards' agenda was to approach the City Council for assistance.

Not wanting the disabled to lose this service, members of City Council agreed to help with an operating grant to assist Kingston's specialized service to continue. At about this time the Ontario Ministry of Transportation and Communications was making surveys to determine the needs of the disabled person, and in July 1979 started funding, on a cost sharing basis, those communities that indicated an interest in providing a service for their physically handicapped citizens.

Previously there seemed to be no written policy but I noticed that those persons who were confined to wheelchairs appeared to have some priority over the semi-ambulatory person, and came to the conclusion that, with very few exceptions, the semi-ambulatory person could be assisted into an automobile.

The M.T.C. must have had a similar idea in mind when they started funding, as their guidelines were quite specific in that the service was to be provided for "THE PHYSICALLY HANDICAPPED PERSON, REGARDLESS OF AGE, WHO DUE TO A MOBILITY IMPAIRMENT, IS UNABLE TO BOARD A CONVENTIONAL TRANSIT FACILITY."

I personally have no problems with these guidelines, as I know of many wheelchair-bound persons who were confined to their residence, whether it be institution or home for many years, prior to the introduction of this specialized service.

Our eligibility criteria is both straight forward and simple. On receiving a call, Trini, our telephone receptionist requests sufficient information in order to send our application form to the callers, and also to learn if they are wheelchair users. If they are wheelchair users, they automatically qualify to use our service, and only have to fill out page one of our application form, which consists of very little more than a place for a name and address. All ambulatory persons must have a mobility assessment and are advised to have their doctor refer them to the Occupational Therapy department at St. Marys of the Lake Hospital. Our Board firmly believes in reciprosity and have no qualms about providing service to the physically disabled visitors who come to Kingston. It is hoped that all qualified disabled will have full access to all disabled transportation systems throughout the country in the near future.

Kingston Bus for the Handicapped now has 10 Girardin Mini Buses, one van and one school bus. All of our vehicles are equipped with the "Q" straint wheelchair tie down system for safety. Our service area is the City and the populated area of Kingston Township.

The type of service we provide is extremely costly. With the taxpayer paying approximately 85% of the cost its extremely important that the service not be abused, and that transportation be provided for only those that truly qualify under the existing guidelines.

We hear from many well-meaning individuals and groups who want us to take their friend or client out. The reasons are many and varied such as "can't afford a taxi," blind, perceptually handicapped, epileptic, etc. I understand their concern and empathize with them, but unless the specialized service is confined to those whom it was designed for, I can see the wheelchair user lose out. There are a number of communities which deviate from these guidelines, who operate

their systems through the goodness of their hearts, but I repeat they are spelling doom for this needed service. One would not expect to have a medical prescription filled at a grocery store or an auto repaired at a pharmacy. By the same token, this service is designed and funded for a specific group of physically handicapped persons whether their conditions be temporary or permanent, but not for all the handicapped, physical or otherwise--I repeat a specific group. I urge you to request your municipal councillors to bring in a by-law that supports the Provincial Guidelines in order for the wheelchair user to continue to participate in the workplace, at the recreation centre and to be able to enjoy a quality of life that was not possible before the Handicapped Bus became a reality.

E. J. Colley
Scheduling Manager.

HOW TO PACKAGE A SUCCESSFUL PUBLIC/PRIVATE PARTNERSHIP IN SPECIALIZED TRANSPORTATION SERVICES

Penny Kay Grabb

Northern Virginia Planning District Commission

How to Package a Successful Public/Private Partnership In Specialized Transportation Services

Penny Kay Grabb
Northern Virginia Planning District Commission

Over the past several decades, the provision of public services often has been carried out in an intergovernmental framework of shared authority and responsibilities among the federal, state and local governments. This sharing, or allocation, of responsibilities revolved around the three principal activities involved in providing a service--planning, financing and producing. During the 1960's and 70's, the federal role in the planning and financing of public services expanded to unprecedented proportions, requiring an equally expanded role for local governments in the production of these services. As the tax burden required to support these services grew and the efficacy of the service programs came into question, citizens, legislators and public administration experts alike clamoured for a re-evaluation of what services are appropriately provided by public agencies, and what role government should play in the provision of these services.

Many experts in the field of public finance have concluded that the failure of "Great Society" programs, and subsequent federal initiatives to solve societal problems, can be attributed to the absence of any kind of mechanism in publicly produced services which assures fluid adjustments in the cost and quality of public services based on client (consumer) satisfaction and preference. Using the free enterprise model, many have suggested that the best way to ascertain client satisfaction or preference is to offer the client an alternative: that is, bring in other suppliers of a service and let the consumer choose. The competition which ensues among the suppliers then helps to regulate the cost and quality of the service being provided.

The notion of "public/private partnership" integrates pertinent concepts of free enterprise economics with concepts of democratic governance, toward serving the objectives of the latter. It retains the roles of the federal, state and local governments in planning and financing public services, but differentiates between public and private roles in the production activity: the regulatory role which is an appropriate governmental function and the actual production function which is an appropriate private sector activity. In this sense, a fourtn "partner"--the private vendor--is brought into the three-tier intergovernmental framework at the local service delivery level.

Of course, local governments have been "contracting out" a myriad of public services to the private sector for years, using a variety of bidding techniques to help assure low cost services. But this form of partnership lacks one important ingredient which another form, the user-side subsidy, utilizes to the maximum extent: the direct, immediate and frequent expression of consumer preference on the balance between cost and quality considerations. With government in a regulatory oversight role, and where there is a sufficient number of potential private sector suppliers, the user-side subsidy approach offers unique and unprecedented opportunities for

efficient delivery of public services with high rates of client statifaction. Nowhere have we found this to be the case more than in the delivery of specialized transportation services.

The user-side subsidy approach delivers a financial subsidy directly to the consumer (user) in the form of a voucher or scrip medium of exchange, to be used by the consumer in selecting the appropriate service to meet his needs from the available private market. Since the subsidy is used by the consumer to purchase service, it differs from the conventional public purchase of private service under exclusive contract, where the subsidy is made to the provider of service, who then delivers service to the consumers pursuant to the contract.

In the late 1970's, local governments in the Northern Virginia region of the Washington Metropolitan Area identified a number of problems in producing specialized transportation services. These problems, representative of the nation's experiences noted earlier, include the following:

present efforts are not sufficient to meet identified needs which are ever-increasing due to higher levels of public awareness of the needs of the mobility-impaired population;

individual agencies' vehicles are often insufficient to serve program clients, yet, due to a need for operating during limited peak use periods, existing vehicles set unutilized the majority of the time;

services between and among agencies are fragmented and duplicative;

agencies found specialized transportation responsibilities (essential in support of primary services) to be burdensome and frustrating;

although accurate identification of transportation-related expenditures are lacking, resource requirements are perceived to be high and existing transportation funding are considered unreliable--as a result, it is difficult to plan and administer effective service delivery.

A workgroup composed of human services staff persons of the Northern Virginia local governments easily deduced that their problems lay in a lack of coordination and service delivery expertise, as exhibited in the large number of individual agency operations. While many of the available agency coordination methodologies did appeared capable of solving some of these problems, they also could create some new ones. The foremost opportunity for changing the means of producing transportation services would be to contract with a private nonprofit or private for-profit corporation for

services. This approach was viewed in Northern Virginia as successful only to the extent that the private corporation would coordinate its contracts with the various public agencies to achieve some operational economies and perhaps improved services for the participating agencies. This "exclusive contract" arrangement with participating agencies leaves little incentive, however, for the vendor to coordinate delivery. While such contracts were an effort to change the means of producing the service, agencies and local governments could not be sure that they would receive the key benefit of private sector participation--the free market mechanism engendered by competition.

In the search for an alternative specialized transportation services delivery system which would truly privatize service production, it was considered essential to:

Preserve governmental roles in the planning and financing activities to assure that the program is implemented within the governmental policy parameters;

Make maximum use of the efficiencies of the free market; and,

Maintain and hopefully improve the quality of services delivery and program effectiveness.

The user-side subsidy approach appeared to have the potential for fullfilling these goals. The appropriate public sector roles in planning and financing could be maintained by the service agencies and direct transportation services could be produced by a "network" of private sector vendors. The parameters within which the services would be provided--e.g., subsidy level, trip restrictions, eligibility requirements and certification policies--would be established by the agencies as part of the program planning, to assure consistency with public goals. In this way, each agency would maintain its identity with its clients and could operate within the bounds of its own program resources. Each agency's expertise in client service would be respected, and the agency's standards of quality would be preserved. Maintenance of agency roles was essential in resolving turf issues which often impede change.

Eliciting the support and cooperation of private sector vendors was the initial step in achieving the efficiencies of the free market. Certainly the profit motive was the strongest incentive, in that the private companies would have a new market of riders to tap. Private transportation services companies (for-profit more than nonprofit) held certain reservations about working with government agencies, including the stereotypical image that public agencies would impose burdensome procedures, regulations, and endless paperwork which would result in increased costs and frustrated drivers. Another of their major concerns was the expectation of delay in reimbursement due to cumbersome, bureaucratic procedures. To meet these concerns, it was obvious that the user-side system eventually to be

developed, since it would not involve a contract for a specified level of service (revenue) with each vendor, had to be administratively simple, both to help contain public sector administrative costs and to insure the cooperation and participation of the private vendors. This was accomplished by making maximum use of the vendor's existing recordkeeping processes and reporting formats and by employing a method of identification of subsidized riders and their funding agency by a single notation by the driver. An identification reference number would be the sole addition to his record-keeping, made on his existing manifest form for each subsidized ride given. The central administration system was streamlined toassure a 15 day "turn-around" time from invoice to receipt of reimbursement. This required a great deal of circumvention of Standard Operating Procedures at both the state and local government levels.

The use of the existing private market of transportation services providers produced anticipated efficiencies, primarily as a result of successfully including all existing taxi and van companies in the market area as vendors. No additional capital investment was required because the market supply was sufficient for the demand, and vehicles to be abandoned by the agencies were available to the companies. Efficiencies of the market system were maximized through competition among the providers to capture ridership. The medium of exchange was money-valued coupons to be used by the riders to "pay" the actual trip cost of each ride. By using money-value coupons as opposed to a non-valued voucher for securing a ride, the users could attempt to "stretch" their coupons by "shopping" for the least expensive service which met their needs--it encouraged thrift. Whether users paid a portion of the value of the coupons or received them free, they were found to treat them just as responsibly as they would cash.

Toward meeting the agencies' goals of maintaining or improving the quality of service and effective delivery of the primary agency program, there were concerns for the quality of service to the predominantly elderly and disabled client population. The competitive network of private vendors enabled users to "shop" also for quality, which, in addition to price, was a means for the vendor to attempt to "corner the market." Again, the use of a medium of exchange which was viewed as money recognized the human behavior element to shop responsibly with limited "funds."

A key element to the program "packaging" components previously cited was the strategy by which they were developed. The personal interaction in the development of the system in both existing and newnetworks were critical to the successful individualizing of each agency's participation. Not only did client needs have to be considered in structuring each agency's services delivery system, but their administrative capabilities and interests also had to be considered. The system's administrative structure was developed to provide as much administrative support as each agency required (and each was different). Therefore, the project staff had to be sensitive to the needs, concerns, and levels of expertise of each agency and design their administrative role accordingly. This was true, to a lesser extent, with the private vendors. Participating entities received as much administrative assistance, or as little, as they each required from the central transportation network administrative unit.

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local government support for the flexibility to adjust level of usage in order to manage resources, due to the absence of funding level obligations and up-front capital investment;

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It proves that a public/private partnership can successfully implement the public goals of specialized transportation services by making maximum use of the competition and personal choice elements of the free market mechanism. Privatization, through application of competition and choice, is a more efficient means of producing public services while also enhancing user satisfaction through a quality of service which equals or exceeds public service delivery.

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How to Package a Successful Public/Private Partnership In Specialized Transportation Services

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Over the past several decades, the provision of public services often has been carried out in an intergovernmental framework of shared authority and responsibilities among the federal, state and local governments. This sharing, or allocation, of responsibilities revolved around the three principal activities involved in providing a service--planning, financing and producing. During the 1960's and 70's, the federal role in the planning and financing of public services expanded to unprecedented proportions, requiring an equally expanded role for local governments in the production of these services. As the tax burden required to support these services grew and the efficacy of the service programs came into question, citizens, legislators and public administration experts alike clamoured for a re-evaluation of what services are appropriately provided by public agencies, and what role government should play in the provision of these services.

Many experts in the field of public finance have concluded that the failure of "Great Society" programs, and subsequent federal initiatives to solve societal problems, can be attributed to the absence of any kind of mechanism in publicly produced services which assures fluid adjustments in the cost and quality of public services based on client (consumer) satisfaction and preference. Using the free enterprise model, many have suggested that the best way to ascertain client satisfaction or preference is to offer the client an alternative: that is, bring in other suppliers of a service and let the consumer choose. The competition which ensues among the suppliers then helps to regulate the cost and quality of the service being provided.

The notion of "public/private partnership" integrates pertinent concepts of free enterprise economics with concepts of democratic governance, toward serving the objectives of the latter. It retains the roles of the federal, state and local governments in planning and financing public services, but differentiates between public and private roles in the production activity: the regulatory role which is an appropriate governmental function and the actual production function which is an appropriate private sector activity. In this sense, a fourth "partner"--the private vendor--is brought into the three-tier intergovernmental framework at the local service delivery level.

Of course, local governments have been "contracting out" a myriad of public services to the private sector for years, using a variety of bidding techniques to help assure low cost services. But this form of partnership lacks one important ingredient which another form, the user-side subsidy, utilizes to the maximum extent: the direct, immediate and frequent expression of consumer preference on the balance between cost and quality considerations. With government in a regulatory oversight role, and where there is a sufficient number of potential private sector suppliers, the user-side subsidy approach offers unique and unprecedented opportunities for

efficient delivery of public services with high rates of client statifaction. Nowhere have we found this to be the case more than in the delivery of specialized transportation services.

The user-side subsidy approach delivers a financial subsidy directly to the consumer (user) in the form of a voucher or scrip medium of exchange, to be used by the consumer in selecting the appropriate service to meet his needs from the available private market. Since the subsidy is used by the consumer to purchase service, it differs from the conventional public purchase of private service under exclusive contract, where the subsidy is made to the provider of service, who then delivers service to the consumers pursuant to the contract.

In the late 1970's, local governments in the Northern Virginia region of the Washington Metropolitan Area identified a number of problems in producing specialized transportation services. These problems, representative of the nation's experiences noted earlier, include the following:

present efforts are not sufficient to meet identified needs which are ever-increasing due to higher levels of public awareness of the needs of the mobility-impaired population;

individual agencies' vehicles are often insufficient to serve program clients, yet, due to a need for operating during limited peak use periods, existing vehicles set unutilized the majority of the time;

services between and among agencies are fragmented and duplicative;

agencies found specialized transportation responsibilities (essential in support of primary services) to be burdensome and frustrating;

although accurate identification of transportation-related expenditures are lacking, resource requirements are perceived to be high and existing transportation funding are considered unreliable--as a result, it is difficult to plan and administer effective service delivery.

A workgroup composed of human services staff persons of the Northern Virginia local governments easily deduced that their problems lay in a lack of coordination and service delivery expertise, as exhibited in the large number of individual agency operations. While many of the available agency coordination methodologies did appeared capable of solving some of these problems, they also could create some new ones. The foremost opportunity for changing the means of producing transportation services would be to contract with a private nonprofit or private for-profit corporation for

services. This approach was viewed in Northern Virginia as successful only to the extent that the private corporation would coordinate its contracts with the various public agencies to achieve some operational economies and perhaps improved services for the participating agencies. This "exclusive contract" arrangement with participating agencies leaves little incentive, however, for the vendor to coordinate delivery. While such contracts were an effort to change the means of producing the service, agencies and local governments could not be sure that they would receive the key benefit of private sector participation--the free market mechanism engendered by competition.

In the search for an alternative specialized transportation services delivery system which would truly privatize service production, it was considered essential to:

Preserve governmental roles in the planning and financing activities to assure that the program is implemented within the governmental policy parameters;

Make maximum use of the efficiencies of the free market; and,

Maintain and hopefully improve the quality of services delivery and program effectiveness.

The user-side subsidy approach appeared to have the potential for fullfilling these goals. The appropriate public sector roles in planning and financing could be maintained by the service agencies and direct transportation services could be produced by a "network" of private sector vendors. The parameters within which the services would be provided--e.g., subsidy level, trip restrictions, eligibility requirements and certification policies--would be established by the agencies as part of the program planning, to assure consistency with public goals. In this way, each agency would maintain its identity with its clients and could operate within the bounds of its own program resources. Each agency's expertise in client service would be respected, and the agency's standards of quality would be preserved. Maintenance of agency roles was essential in resolving turf issues which often impede change.

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Of course, local governments have been "contracting out" a myriad of public services to the private sector for years, using a variety of bidding techniques to help assure low cost services. But this form of partnership lacks one important ingredient which another form, the user-side subsidy, utilizes to the maximum extent: the direct, immediate and frequent expression of consumer preference on the balance between cost and quality considerations. With government in a regulatory oversight role, and where there is a sufficient number of potential private sector suppliers, the user-side subsidy approach offers unique and unprecedented opportunities for

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It proves that a public/private partnership can successfully implement the public goals of specialized transportation services by making maximum use of the competition and personal choice elements of the free market mechanism. Privatization, through application of competition and choice, is a more efficient means of producing public services while also enhancing user satisfaction through a quality of service which equals or exceeds public service delivery.

Fare Wheels was developed by the Northern Virginia Planning District Commission and initiated cooperatively by Arlington County and the City of Falls Church, Virginia. Arlington County has maintained sponsorship of this interjurisdictional specialized transportation network which has recently expanded to serve the City of Fairfax. Exhibits of trip volume and costs, participation data, forms, brochures and reports can be obtained from: Penny Kay Grabb, Coordinator, Community Assistance Programs, Northern Virginia Planning District Commission, 7630 Little River Turnpike, Suite 400, Annandale, Virginia, USA 22003; Telephone 703/642-0700.

ESSENTIAL CONSIDERATIONS IN PRIVATE/PUBLIC CONTRACTING FOR ELDERLY AND HANDICAPPED TRANSPORTATION

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Essential Considerations in Private/Public Contracting for Elderly and Handicapped Transportation

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I. INTRODUCTION

Recent federal policy has mandated the use of private providers in transportation wherever practical. The reason given for this policy was that private/public contracting provides competition at the least cost for the best quality services. It was also thought that contracting out certain services would put a halt to unlimited governmental growth. It is still too early to tell whether these underlying premises are true. Certainly there are serious questions still to be answered about quality and extent of services, as well as about the bookkeeping necessary for true cost comparisons.

The purpose of this paper, however, is not to compare the cost-effectiveness of contract vs. non-contract services. It is intended instead to provide organizations interested in contract services with information from both the private and the public perspective. It is only when both sides understand the goals and constraints of the other that a good contract document can be written.

Some specific assumptions underlying the current policy to contract out transit services include:

1. Competition causes bidders to eliminate waste, since contracts are awarded to those offering the best quality services at the least cost.
2. Substitution of the profit motive for budget maximization and empire-building would help to limit budget growth and, by extension, government growth.
3. Economies of scale can be realized in some jurisdictions through reducing overhead or by spreading costs over a number of units.
4. High personnel costs can be lowered, primarily by avoiding public employee unions and traditional public personnel benefits.
5. Greater flexibility in the use of personnel and equipment may be achieved for short term projects, specialized needs, or new problems, without a commitment to sustaining a bloated bureaucracy.

What the authors would like to do in this paper is to examine the various roles played by government and private providers, look at what some of the "myths" associated with contracting out, and, finally, provide some practical guidelines for developing meaningful contracts.

II. ROLES IN CONTRACTING

GOVERNMENT: The role of government is to explore alternative methods of service delivery and to use quasi-market mechanisms for services. Three critical contracting decisions that governments face are: (1) choosing between government service supply and contracting out; (2) picking the type of service delivery to meet the needs, and (3) selecting among alternative delivery agents. The public agency must set goals for each of these steps, draw up the proper procedures to encourage competition, develop strategies for cost reduction and quality service, and perform careful service evaluations. One of the real challenges facing government bodies is to write clear but not excessively restrictive guidelines, regulations and specifications for outside agencies to follow when implementing their programs.

PRIVATE NON-PROFIT

The private non-profits were created to fill a void in E&H service delivery. They were given financial breaks in the forms of start-up and capital equipment grants. With the advent of this new policy favoring private providers, many non-profits are facing stiff competition and may be forced out of direct E&H service. According to UMTA guidelines of January 24, 1986, these private non-profits are not considered as part of the private sector. It is not surprising, then, that many non-profits are suffering from identity crises in the wake of private sector challenges. What they are concerned about, in addition to their own viability, is the ability of the private sector to maintain stable, safe operations over the long run.

PRIVATE FOR PROFIT

Private for profit companies are not all created equal. There are those which are well organized, safe and efficient and those that are not. Sometimes, however, it is hard to discern which is which before awarding contracts. Managers of well run operations will be careful to get very complete and clear answers to the following questions before making a bid for a service contract:

1. what service is to be provided
2. what that service will cost
3. what will happen if conditions change or expected performance levels are not met, and
4. when will payment be made for services rendered.

It is the private sector itself, however, that must take the lead role in putting public transport on a profitable basis. A major role in this process can be played by taxi firms, livery operators, intercity carriers, independent bus operators, and school bus operators. These and other firms form the catalyst for competition in private sector supply of public transportation.

This does not mean that government no longer has a role in public transit. As Wendell Cox pointed out at a Public/Private conference in Los Angeles in 1984, "It is not the abdication of the public role to private providers -- rather it is public authorities retaining full policy control while contracting services where public funds can be conserved or greater flexibility achieved."

III. THE PROMULGATION OF MYTHS

Much debate is currently raging on the benefits of private vs. public provision of transit service. Unfortunately, there is still very little empirical evidence one way or the other. Although there are several studies cited in the pro-contracting literature, these need to be looked at carefully. According to the figures in these articles, there seems to be some indication that private contracting may be less costly. However, many of the direct cost comparisons to date are flawed because:

1. difficulty in identifying all the costs associated with each service delivery alternative; (for example, increased insurance claims that might not show up immediately)
2. underestimation of some costs;
3. failure to take into account long range cost impacts;
4. a tendency to overlook certain administrative costs associated with the entire contracting process -- from the initial writing of bid specifications, through careful monitoring of contracts for compliance.
5. the fact that budget systems vary widely from public to private agencies, and
6. failure of these studies to include a comparative analysis of the quality and breadth of the forms of service delivery.

This brief review of a few of the problems in the current contracting literature is designed to point out some areas for further study. Some of the contradictory points that need to be empirically studied include the following:

POINT 1: Contracting is more efficient because,

a. It harnesses competitive forces to streamline inefficiencies.
b. By focusing on each program directly, it permits better program management and evaluation; contracting to an outside agency also can get management out of the very political context of public agencies.
c. The costs and benefits of managerial decisions are felt more directly by the decision makers, whose own rewards are directly at stake (on both public and private sides).

COUNTERPOINT 1: Contracting can be more expensive because of

a. The corruption that often accompanies the bidding for high municipal contracts.
b. The desire for ever higher profits on the part of private providers.

c. The cost of layoffs and unemployment for government workers who lose their jobs to private providers.
d. A shortage of qualified transportation suppliers and a consequent lack of competition.
e. The cost of managing the contract and monitoring contractor performance.
f. The low marginal cost of expanding government service.
g. Cost-plus-fixed-fee provisions in some contracts, which provide no incentive for efficiency.
h. The absence of effective competition in "follow-on" contracts, which are commonplace.

POINT 2: Contracting allows flexibility in adjusting the size of a program up or down in response to changing demand and to changing availability of funds.

COUNTERPOINT 2: Contracting limits the flexibility of government in responding to emergencies.

POINT 3: Contracting permits a quicker response to new needs and facilitates experimentation in new programs.

COUNTERPOINT 3: Contracting causes a loss of autonomy of the contractor and, therefore decreases the latter's effectiveness in the long run by meeting its role as critic and competitor. In the long run it can cause "follow-on" contracts when certain conditions are not present.

POINT 4: Contracting is a way of avoiding large capital outlays; it spreads costs over time at a relatively constant and predictable level.

COUNTERPOINT 4: Entrusting some services to private organizations might increase their political power to such an extent that there would be a general loss of competitive edge for other private and public entities.

POINT 5: Contracting a portion of the work offers a yardstick for comparison; the cost of the service is highly visible in the price of the contract, unlike most government services.

COUNTERPOINT 5: Contacting depends on adequately written contracts, which are difficult to draw up and as a result there is a loss of government accountability and control.

POINT 6: Contracting can reduce dependence on a single supplier (a government monopoly) and so lessens the vulnerability of the service to strikes, slowdowns, and inept leadership.

COUNTERPOINT 6: Contracting fosters an undesirable dependence on contractors and leaves the public vulnerable to strikes and slowdowns by contractor personnel and to possible bankruptcy of private firms.

These points and counterpoints illustrate the fact that there is

generally insufficient evidence for a real world comparison over an appropriate length of time. When there is such a lack of facts, often myths are conjured up to fill in the blanks. In the case of contracting out for certain public transit services, the myths are:

MYTH 1: The essential role of government in the contract process is to serve as financier for public service.

EXPERIENCE 1: The essential role of the government agency or elected body would be to act as a watchdog. Not only would it deal with revenue gathering or budget allocations and transfer of payments to the proper agent, but it would also choose the providers, monitor and evaluate their performance and establish standards via long range planning.

MYTH 2: In the competition arena, the more participants bring the best results.

EXPERIENCE 2: Private contractors often need a certain volume of business to make their participation profitable. When a market is divided into so many pieces that too many participants get only small amounts, the slice of market may not be worth the effort.

MYTH 3: In all cases, government contracting to private providers fosters reduced cost and diminishes government growth.

EXPERIENCE 3: In services that require large initial investment for specialized equipment, there are often only one or two local firms with the potential for producing the desired service. While in principle the government can replace unsatisfactory providers and contract with more efficient and effective ones, this option will often be unavailable because of a shortage of other responsive and responsible providers.

MYTH 4: When contracting out for transit services, competition is the main mechanism for holding down costs and upgrading services.

EXPERIENCE 4: There seems to be some evidence to suggest that traditional economic doctrines about competition will not apply to contracting out. The reasons given are: (1) a general shortage of the kind of responsive, responsible provides needed to make such an operation a success; and (2) the lack of desire or capability of local officials to create a competitive environment.

MYTH 5: In the marketplace, perfect competition requires that demand and supply conditions be independent.

EXPERIENCE 5: In reality, providers often influence demand. The belief that desires for particular services are indigenous is naive. The consumer seldom enters the market place with a good idea of the service s/he requires. Instead, providers often use selected information or specialized equipment to mold preferences, creating and shaping needs.

MYTH 6: Beneficial contracting requires many contractors to promote competition. There aren't enough contractors interested or

locally available.

EXPERIENCE 6: It has been seen recently that private providers are increasingly willing to participate in bidding and investments in cities other than their home base. These providers generally have strong financial bases and the managerial flexibility needed to expand.

On a very positive (and preliminary) note, there is some evidence that private/public contracting does work. Each perspective may not be an accurate model of a complex reality. What is necessary at this point is more empirical research that examines not only the outcomes but also addresses the conditions and processes involved.

IV. Contracting Guidelines

Many of the contract guidelines that are found in the current literature are written by observers of the process. The following operational guidelines were developed by a private for profit contractor in the Chicago area which started operations during the early 70's. This contractor addressed the needs in the paratransit market through purchase of services with human services agencies, rehabilitation agencies, and offices on aging. This led to the development of a hybrid specialized service under contract with the Chicago Transit Authority (CTA). These experiences serve as the model for incentive types of contracts. In other words, the incentive of receiving more money for more people carried led to cost reductions of more than 50% while increasing service delivery by more than 100% without a CTA budgetary increase.

Contracting for existing transportation related services is an effective way to utilize private providers in order to help control costs and use their flexibility to increase service delivery.

The private provider is in the business because he's willing to take the punches and solve problems with new ideas and investment. Through him you can make fast course corrections and communicate changes to the public. The private provider justs needs to know that there is a good reason for a real problem to be solved and he'll be right beside the authority in the trenches. If guarantees are necessary, build them into the contract. Just remember, "you get what you pay for," so don't always look at the bottom line as the only indictor.

The following areas are particularly important in dealing with private providers:

WRITE CLEAR, FAIR BID SPECIFICATIONS

When specifications for bids are tendered, they must be all inclusive, yet not arbitrary.

- --Do not request unnecessary protection in the form of high insurance limits or unrealistic protection for your authority.
- --Do not demand reporting standards that intrude on a provider's other businesses or cause excessive paper shuffling.

--Do not make general reference to compliance and expect the contractor to interpret what is correct for your service.
--Do not make accountability so arduous that extra costs are created.

Bid bonds and performance bonds are constructive. To get them, a contractor must be secure, to begin with, and to lose them will jeopardize any future business that a contractor can perform.

Assign costs to specific indicators of performance failure. Withhold all or part of fares and trip or hourly fees for different levels of performance or failures. This money can be channeled back to purchase more service, or further reduce deficits.

The authority should recommend that contractors, monitor their own service, as-well-as employ it as a tool to monitor what service is performed. To do so, requires current information on trips being purchased, (with details on each).

Accountability is important to the authority and the contractor. A good contractor will check his own service and can later use recorded statistics as a measure of any needed changes. Accountability must never be used as an excuse for slow payments. If, in fact, payments become delayed by an antiquated system, the providers motivation will be seriously jeopardized.

BE AS OPEN AS POSSIBLE:

Requests for qualifications are part of the contract documentation. However, before an authority asks the providers to qualify themselves, they should be as open as possible about what they want and how much they can pay for it. Some questions that providers need answers to are:

-- Why is there a contract at this time?
-- What is the history of the program?
-- What service elements are changing?
-- What has it been costing?
-- What realistic costs need to be achieved?
-- How big ($) is the contract?
-- How much capital investment is involved?
-- How long is the depreciation period?
-- What guarantees are required?
-- Are contracts available to small businesses? (momma-poppa)
-- What is the payment schedule?
-- How much paperwork is involved?
-- How is liability shared?
-- How much insurance?
-- Is there a union and what are the stipulations?
-- What is the present structure (overhead, capital, etc?)
-- Are there safeties if a contractor gets in trouble?
-- How much training is required?
-- Exactly what service must the drivers provide?
-- Are uniforms required?

-- How complicated are the reporting standards?
-- Are there ceilings on profitability?
-- Are there DBE or WBE requirements?

Put the information before all potential providers at a public meeting. Don't think that just because you have the business that they must come to you. They must be reassured that by working with you, they will not:

-- Inherit your union problems
-- Be driven into bankruptcy by contract demands in small print.
-- Lose money, but save money for taxpayers.

REQUEST QUALIFICATIONS

Once the authority has the private provider interested and available, then it is time for the authority to ask for qualifications. Demand good qualifications from your providers by asking for:

-- Strong financial statements.
-- Substantial operating experience.
-- Willingness to employ proven professionals in specific fields.
-- Documented training and maintenance procedures.
-- Clear managerial guidelines, so that you know who is responsible for what.
-- Adequate driver pay and benefits.
-- Ability to meet insurance demands.
-- Ability to meet bonding requirements.
-- Driver standards.
-- Sensitivity to the public's demands.
-- Ability to expand with demand.
-- Ability to keep proper records and documentation.
-- List of current customers and volume of business.

A review of this sort of information is not enough. <u>Sites should be visited</u> by the experts in each area. At each site maintenance facilities, buildings and fixtures should be <u>thoroughly inspected</u>, <u>staff should be interviewed</u> and <u>accounting procedures evaluated</u>. Anything that cannot be seen, including assets, communications, tools and repair facilities should not be accepted. Sites where work is to be accomplished should be visited if subcontractors are proposed.

DEMAND WELL MAINTAINED, APPROPRIATE EQUIPMENT

Vehicle requirements should be broad, but high maintenance and operating standards should be demanded. Any vehicle can be made to work; it's how the contractors operate and maintain the vehicles that counts. The most appropriate vehicles are those with the need for little maintenance, good fuel economy, and capacity to match ridership.

SOLICIT RIDER FEEDBACK

Passengers have been oriented to ride on monopolistic, public mass transportation. From this perspective they take and accept what they receive. With smaller vehicles and more personalized service, passengers tend to become much more aggressive about voicing their opinions. It is important to try and ensure that this passenger input represents a broad range of clients, and not just a vocal few. Passengers have a responsibility to critique transportation in a constructive manner, whether it is in the public or private sector. Constructive criticism insures quality service. However, when passenger demands are unreasonable, the authority should not be afraid to support its contractors.

MONITOR DRIVER TRAINING AND PERFORMANCE

To assume that highly paid union rates make drivers more aware or sensitive to the public they serve is overly simplistic. They may be more conscious of losing a good paying job, but higher pay does not ensure quality performance. When the public transit properties contract service to the private sector, it is the responsibility of that public agency to include contractual obligations that will set employment standards for private sector employees.

ENCOURAGE SAFE VEHICLE AND DRIVER PRACTICES:

Safety is more than catch phrases, glossy pamphlets or classrooms. Safety includes follow-up monitoring. The ultimate control is, "if you have an accident, you're fired." Many long standing private firms still subscribe to this approach, and are successful. In contrast, the most a transit property can do to counter irresponsible driving is often a day or two suspension without pay. Vehicle and operating safety must be clearly delineated in contract specifications. Of course there are unsafe operators, but they should never get a contract with a public carrier.

BE SPECIFIC ABOUT MARKETING REQUIREMENTS

If the public properties want operators to share in marketing efforts, let them know up front. What are the costs? What is the intended result in each case? If such a need is anticipated, it should be included in the request for bids.

DEMAND HIGH, BUT REASONABLE, SERVICE STANDARDS:

In some cities people ride on public transit vehicles with no air conditioning when it's 80 degrees in the shade and the windows can't be opened. In other cities when the wind chill reaches 30 degrees below 0, doors and windows on coaches won't close and there is no heat. Sometimes routes aren't run because of breakdowns or employees don't show up. Any of these or numerous other factors can affect service quality.

Keep in mind that private operators are also affected by these day-to-day service hazards. However, the generally smaller fleet size of privates, along with more personalized maintenance goes a long way towards alleviating some of these potential hazards to service quality. To ensure quality, build some sort of punitive measure (like fines) into the original contract. Make sure, however, that you are very clear on what constitutes failure to comply (a broken heater for one day, or one week?)

MAKE RECORD KEEPING SIMPLE BUT THOROUGH

Keeping records is as hard for the private sector as it is for the public sector. Both public and privates can benefit by records that reflect performance and actual costs. However, records kept only for funding agencies, without regard for operating costs, will have some costs assigned to them. It's important to reduce the demand for information collection at the operating end and make this the property's responsibility through existing infrastructures. Don't view this as a chance to dump reporting procedures.

KEEP SERVICE AREAS REASONABLE

The geographic area which can be served by the private sector is potentially the same as that served by the public sector. As an extension of the public sector, private companies would presumably be limited to the same geo-political boundaries. If a private provider must expand his current coverage, he will purchase additional locations, just like the public sector. In addition, private and public sector operators have the same requirements for interlining to reduce vehicle and driver requirements and non-revenue hours. Thus it is necessary to structure a geographic area in such a way to maximize interlining.

HELP PROVIDERS ACHIEVE COMPLIANCE

Public operators are generally the ground transportation provider for a region, by charter. Therefore, licensing and permits are authorized by the urban area they serve. This is not so for private operators. Livery, taxi, medical, school bus and weight plates do not symbolize public authority to operate. Authorities should <u>not</u> ignore licensing regulations by simply including language to "assure that all federal, state and local laws or ordinances governing vehicles in service are operated in compliance." In many cases the strict interpretation of such a clause is impossible. Authorities should participate in the planning stages to determine what regulations must be enforced. Bad planning generates additional expenses such as cost of permits, insurance, etc.

MAKE CONTRACT PERIOD APPROPRIATE

Just as authorities must spread out the cost of certain capital expenditures, so does a private operator. If the operator buys new equipment, three to five years many be required to depreciate that equipment. Of course, the longer a contract is in effect, the greater period this expense can be spread over. If contract periods are short an operator must be free to purchase less expensive or used capital equipment

in order to keep costs down. If a private operator provides a new transit bus, 12 hours per day over a 24 month contract, his initial commitment represents over $20 per hour, without a guarantee of additional time or resale of the equipment. A third year reduces his cost by over $5 per hour, a savings that would be passed along to the contracting authority.

V. REMARKS

We would like to conclude with two crucial points about contracting. The first is that there must be a complete understanding --ahead of time-- of what services are to be delivered and what those services will cost. If the contracting homework has been done and the guidelines cited above followed, the agreement should go smoothly. The second point is that any commitment of time, effort, money or resources is costing somebody money in delivery. Recognizing this fact, all arrangements must be made by mutual agreement. All the service, performance, and administrative levels which are stipulated should be in accord with goals and objectives set up on the public and private side as well.

This paper doesn't intend to provide any easy answers to the private/public contracting debate. What it does do it point to many of the difficulties in cost comparisons, and provide a blueprint for contracting that can preclude many problems. Below are some suggestions for when contracting may be appropriate:

1. Where demonstrations, services or methods can be tried without long-term commitment to continuing programs.
2. When there is a desire to cut costs and maintain quality service,
3. Where the public sector does not have the experience or equipment to deliver the E&H service,
4. Where government can retain a watchdog role and set priorities, service levels, and outcome goods with the option of reward or punishment based on fulfillment,
5. Where there is adequate competition in the environment to ensure government choice,
6. Where fair competitive procedures can be enforced,
7. Where politically motivated awards can be minimized,
8. Where government agencies have the resources and desire to implement effective oversight methods.

This is just the start of a list that is likely to grow as more information is collected about private/public contracting. Honest and thorough attempts at studying the various phases of the contracting process will be needed to make our information base complete. It is the intuitive feeling of this team that contracting will continue to grow, even if the jury is still out regarding the model way of approaching it. We hope we have provided some positive suggestions for future private/public transit ventures.

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Private Involvement in Transportation for the Disabled: The Chicago Area

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Private Involvement in Transportation for the Disabled: The Chicago Case

Chicago's innovative actions to involve the private sector in public transportation have played an important role in transportation for disabled individuals. The Chicago Transit Authority (CTA) has recently contracted with four private transportation firms for special paratransit service for disabled individuals; this new service replaces a paratransit system that CTA operated themselves. The change was in response to three sources: 1) pressure from the disabled community to increase capacity; 2) high unit costs; and 3) promotion of contracting for services by private transportation firms. As a result, the CTA developed a hybrid contractual arrangement that combines the competitive advantages of user-side subsidy programs with the greater control of a more formal contract.

In a unique arrangement, the private sector will have a voice in the evaluation of the new contract service. As part of a demonstration project to involve the private sector in planning public transportation, an advisory committee of representatives from the CTA, the private transportation firms operating the service, the metropolitan planning organization, the disabled users, and the Urban Transportation Center of the University of Illinois at Chicago has been created to evaluate the new service.

This paper will describe the events leading to the private sector involvement, the new service, and the evaluation process.

TRENDS TOWARDS PRIVATE INVOLVEMENT

The 1980s have seen several changes in public transit operations that have begun to encourage some return toward private operation of public transportation. First, in 1981, a "fiscal crisis" of the Northeastern

Illinois Regional Transportation Authority (RTA; the funding agency for the Chicago metropolitan area) led to a drastic increase in fares in an effort to cover the deficit. Fares on the commuter rail system approximately doubled. In response, several individual commuters chartered buses from private companies, located from 40 to 50 fellow commuters making similar trips who were willing to share the cost, and started commuter clubs. These were privately organized, privately funded, and privately operated transportation. The services were profitable to the private charter companies although they were in competition with publicly subsidized commuter rail service that charged higher fares. Commuter clubs increased in number to a peak of more than 80 individual runs in 1981-82, but gradually dropped to a level of 15 to 20 runs by 1984. Their failure is due to lack of interest in overcoming the marketing problems (e.g,, how to locate potential replacement commuters as the original commuters drop out due to job changes) and to a new stability in commuter rail fares not to the infeasibility of this type of transportation (McKnight and Paaswell, 1985). The commuter club movement had little to do with transportation for the disabled; it did suggest to many people that private operators have a place in the overall transportation system.

In 1982 a group of private transportation operators (e.g., taxi firm and charter bus companies) in the Chicago region formed the Metropolitan Transportation Association (MTA) with the objective of educating themselves about public transportation and lobbying for a larger role in the delivery of public transportation. In 1983, the Transit Study Corporation (TSC) spun off from the MTA; this is a smaller group of private companies with the object of actively pursuing public contracts. TSC contracted with the Urban Transportation Center at the University of Illinois at Chicago to analyze the potential cost savings to the CTA of replacing specific CTA operated service segments with privately operated service under contract (McKnight and Paaswell, 1984). The purpose of this study was to provide information to TSC

on the feasibility of assuming any type of the currently CTA-operated service based on a comparison of CTA costs and private operator costs.

This study showed there were potential savings to CTA from a few to 60 percent if CTA were to contract for fixed route bus service on specific routes. The study also indicated that CTA could save approximately 50 percent of the current costs of CTA's Special Services for disabled persons if they were to contract rather than operate them inhouse.

The Transit Study Corporation decided to actively pursue a contract to operate the special services. First, they changed their name to Transit Service Corporation. Then, they commissioned the Urban Transportation Center to help them prepare a proposal to CTA for the provision of special services. The proposal (Urban Transportation Center, 1985) laid out in great detail the service and performance standards that TSC proposed to provide.

THE CTA CONTRACTED SPECIAL SERVICE

The CTA was well aware that the inhouse special services were expensive. In early 1985 the cost was approximately $28 per passenger trip not including capital. The CTA budget for the service was $4 million per year providing about 500 trips per day. Demand was much higher than could be accommodated; about 100 requests for trips were refused daily. The users of the system were lobbying for an expansion of the service, but the CTA Board could not allocate additional money to special services because they were having to consider service cuts elsewhere in the system due to financial problems. The Board's response was to instruct the CTA staff to find a way to double ridership within the budget either by contracting or by increasing the productivity of the inhouse operation. While increases in the productivity of the current system were quite possible, doubling productivity was most unlikely. Given the existence of the TSC proposal to do the service for half the cost, contracting seemed the best option.

TSC lobbied to be the sole operator of the special services. They argued that there were major economies of scale in having one operator for the entire service. TSC also claimed that having only one operator would allow better control by the CTA. The CTA staff, however, felt that there were major advantages to the competition arising from having several operators bid for an operate service.

CTA's staff studied the contracting and brokerage arrangements of several other large transit agencies. They particularly liked the user-side subsidy program used in Milwaukee, which promotes competition between private operators. Rather than having a contract with one or several private operators, Milwaukee allows the certified users of the program to use any qualified operator; the user pays a percentage of the trip cost and the operator submits a voucher for the remainder of the cost. The operators compete for users by offering good service (and to a small extent, lower prices). Milwaukee relies on competition to maintain quality and limits their monitoring primarily to watching for fraud.

While CTA liked the Milwaukee system, they felt that the environment in Chicago was different and required greater control. The users of their service were opposed to private operation partly in response to bad past experiences with some private operations. They also felt that CTA was considering contracting as a means of abdicating their involvement in transportation for the disabled. Thus they developed the system which they refer to as a hybrid user-side subsidy program.

CTA's eventual program provides for contracts with four private firms, each of which operates throughout the city of Chicago. (TSC is one of the four.) Users can call any of the operators to arrange for a trip. The contracts specify strict service characteristics and provide for close monitoring by CTA. All trip requests are recorded on a central computer, allowing CTA to

monitor the trip records on a daily basis. (See Roth and Marx, 1986, for a full description of the service and the contracting process.)

Initially CTA held weekly meetings with the four operators. The meetings allowed for discussions of problems with the service (problems from the point of view of either CTA and/or the operators) and potential solutions. Several changes in procedures resulted from the meetings, making it possible to fine-tune the design of the program after the contracts were signed.

From CTA's point of view, the contracted service has met the main objective of doubling capacity within the budget. In April 1986, they paid an average of $12.53 for a passenger trip (each firm is paid a different price); CTA estimates that administration costs are about eight percent bringing the cost per trip to close to $13.50, under half of the cost of the inhouse service. In the full first month of private operation, ridership doubled from an average of 12,500 trips per month to 25,000 trips. Because of a $3 million grant from the State of Illinois, CTA has not had to limit trips so far. By April 1986, monthly ridership had reached 40,000 trips per month, more than triple the pre-contracting ridership (Roth and Marx, 1986).

There have been other benefits. For example, while CTA had operated only small buses (24 and 35 foot vehicles), the private carriers operate a range of vehicles from sedans to vans to small buses, which are better tailored to the needs of the disabled users. Also the private carriers have been able to expand their fleets as ridership has grown; at no point has lack of vehicles limited ridership. CTA, as a public agency, would have had to go through a lengthy capital purchasing process that would have temporarily constrained ridership aside from the budget constraint.

PRIVATE INVOLVEMENT IN PLANNING AND EVALUATION

In the meantime, the MTA, the larger organization of private operators, was directing their attentions toward getting a voice in the public transportation

planning process. They lobbied for a seat on the Policy Committee of the metropolitan planning organization, the Chicago Area Transportation Study (CATS). (The U.S. Department of Transportation requires that each metropolitan area have a metropolitan planning organization that is responsible for coordinating transportation for the region. In Chicago, this organization is the Chicago Area Transportation Study (CATS), and the Policy Committee of CATS is the highest policy-making body within the Chicago area transportation planning system.) Initially the MTA's request was turned down, but CATS took several actions which improved communications between the two sectors. Most importantly they established a Private Providers Advisory Committee which acted as a forum for the private operators to discuss their concerns and to advise the Policy Committee on issues involving them. Then in 1984, as part of a general review of membership of the Policy Committee, the issue of a seat for the private operators was taken up again and this time representatives of the private operators got seats on both the Policy and the Work Program Committees. (McKnight et al., 1986).

The benefits of private participation in the planning process are likely to occur several years hence. Thus, a discussion of outcomes at this stage is preliminary. So far the major benefit has been that of educating both the public and private sectors about each other. More specific outcomes have been the provision of a forum for the operators to express their concerns, further organization of the private sector, and the expansion of private contracting options.

As the private sector representatives attend Policy Committee meetings, they are becoming more aware of the complexity of the issues being addressed and the need for specialized knowledge if they are to have meaningful involvement in setting policy and contributing to the plans being considered. Because of the time required to attend the requisite meetings, it is very costly for any single company to participate in the planning process.

Therefore, in November 1984, MTA presented a proposal to the Unified Work Program Committee for public funding of staff for the MTA. The MTA felt that support for a staff person would allow better participation. As stated by a representative of MTA, the intent of the proposal was to ensure private input and guarantee coordination.

The MTA request for UWP funding resulted in considerable discussion about the use of public funds to support a private organization. While the UWP committee declined to provide funds, they did recognize the problem faced by the MTA. The CATS staff, at the direction of the Steering Committee of the Private Providers Advisory Committee, developed a cooperative project proposal to provide public funds to support private sector participation. After considerable negotiation between CATS, MTA, and the public agencies, a final proposal was prepared and submitted to UMTA; UMTA announced funding for the project in July 1985. For the first time public funds would be used to support private sector involvement in the planning process. The project promotes coordination of private involvement and also funds three technical studies aimed at developing and evaluating opportunities for increased use of private carriers to operate transit services.

One of the three technical studies is the evaluation of the CTA's contracted special services. An interagency committee was formed consisting of representatives from:

- Chicago Transit Authority
- Chicago Area Transportation Study
- Regional Transportation Authority (the metropolitan funding and oversight agency)
- Metropolitan Transportation Association
- CTA Mobility Limited Advisory Committee
- Urban Transportation Center, University of Illinois at Chicago

Two of the private contractors are members of the MTA and the other two have been invited to join. Thus, the committee represents the public provider, the

private operators, and the users, as well as three agencies with broader interests in transportation for the region.

The committee meets every two or three months to discuss how the service is working, problems with the service, and the resolution of past problems. In the first year they issued two working papers: One describing the contracting process and the changes in the service from when CTA operated the service inhouse (Chicago Area Transportation Study, 1986A); and the second documenting the views of the private contractors concerning the contracting process (Chicago Area Transportation Study, 1986B). Both of these papers were written in the first few months of the contractual service. A third working paper proposing an evaluation process and performance measures has been started. This paper tries to incorporate the points of view of the provider, the operators, and the users as well as the general public. In the second year the committee intends to complete the general evaluation as well as write working papers evaluating the success of the contracting after a year of operation from the points of view both of the CTA and of the private operators.

Several points have come to light through the private/public evaluation committee. The first was the private operators' confusion over the bidding process. They were accustomed to the low bid system, which for many years was required by the U.S. Department of Transportation. However, CTA used a three-step selection or negotiated bid process, which has recently been allowed. After screening the qualifications of interested bidders, CTA interviewed those bidders who met certain requirements. The interviews allowed the bidders to learn more about the service and allowed CTA to learn how the private firms operate. As a result, CTA changed the program design in several ways. The third step was to request a bid. Six bidders were chosen based on the quality of the proposed service. CTA then negotiated with these six

companies for a final price. Four companies were chosen on the basis of price and quality combined.

From comments made by the operators to the evaluation committee it became clear that at least some of them did not understand the negotiated bid process and one apparently did not realize that such a process was legal.

Another point was the difficulty in estimating costs. Bids were for a price per passenger trip. The operators usually estimate their costs on an hourly basis and some of them had difficulty allocating costs on a per-trip basis. At least one of the four may have under bid and is asking CTA to review their price.

A final point was the doubt that the private operators had concerning the amount of competition. Some said that four carriers was too many; one claimed that one carrier could provide the service better and cheaper and a single contract would have allowed more control by CTA. Another operator claimed that the users were sticking with one carrier rather than trying them all and therefore the competition was not working as a means of maintaining service quality. However, it is not clear that he could know whether the users switch between carriers; additionally, the remark was made very early in program. The evaluation committee hopes to determine how much the users do try different carriers.

SUMMARY

The Chicago Metropolitan Area has seen a unique approach (for the United States) to the delivery of services for the handicapped. First, the quality and type of service is completely controlled by the public transit operator. Second, the private sector, through a conglomerate of operators, actually delivers service according to specified standards for the public provider. Finally, the private operators have a seat and voice in the metropolitan planning organization, a harbinger of new concepts in service delivery for the 1980s and beyond.

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VOLUNTEER WHEELS
A VOLUNTARY PARATRANSIT PROGRAM

A PROGRAM OF THE VOLUNTEER CENTER
December 9, 1985

by
Dennis E. Studebaker
450 College Avenue
Santa Rosa, CA
U.S.A.

December 9, 1985

VOLUNTEER WHEELS

A VOLUNTEER PARATRANSIT PROGRAM

by Dennis E. Studebaker

Since the advent of the automobile, the peoples of the world have become more and more mobile, especially in the industrially developed nations.

My 90 year old grandmother can chart the dizzy course of accelerating mobility in our society from the horse and buggy days of her youth to the high-speed computer automated cars of today.

The pros and cons of this evolutionary step in our society can be argued to exhaustion. Certainly the automobile has revolutionized our culture and enhanced our freedom of mobility. Most of us enjoy our cars and don't think about the day when we are no longer capable of driving them.

Consider for a moment what your plight would be if for one reason or another you couldn't drive and also couldn't ride the bus.

The store which was only ten minutes away by car or bus is now inaccessible to you. Buying the necessities for survial, not to mention decent clothing or an item you need in order to fix the leaky sink in your bathroom, becomes a major challenge. You find yourself suddenly dependent upon friends and family as your transportation link with the world. The trouble is that most families are two-income producing and people are rarely home during the day when you need transportation. Taxis, you discover, are reliable but very expensive, At worst consequence, such a situation is life-threatening, particularly when you need medical attention or food.

450 COLLEGE AVENUE, SANTA ROSA, CA · (707) 544-9485

At best, your options for a full and enjoyable life are severely limited. You are "Transportation Handicapped." Section 16(c) of the Urban Mass Transportation Act of 1964 defines a transportation handicapped person as:

> "Any individual who, by reason of illness, injury, age, congenital malfunction, or other permanent or temporary incapacity or disability, is unable without special facilities or special planning or design to utilize mass transportation facilities as effectively as persons who are not so affected."

This is the fate of many of our senior and disabled citizens. We live in a society that has designed itself according to the freedom of mobility created by the automobile. There is a great deal of distance now between homes and shops and services. People who no longer can drive or ride the bus need help from their community. They need to have low-cost transportation that can pick them up at their home and take them where they need to go. PARATRANSIT was born in response to this need.

The root "para" means beside. Therefore, paratransit is transportation which works "beside" transit, providing door-to-door demand responsive transportation for people who can no longer drive and are unable to ride the bus or afford a taxi.

There are literally thousands upon thousands of paratransit systems operating in America today, each uniquely designed by and for the communities they serve. Some exclusively employ paid drivers who operate vans. Some agencies have volunteer drivers exclusively and are even administrated by volunteers. Some, such as Volunteer Wheels, are a mixture of paid and volunteer drivers, administrators, schedulers and dispatchers.

Volunteer Wheels is a service of the Volunteer Center of Sonoma County in California. We began our operation 10 years ago in response to the need for paratransit in our community. The Volunteer Center is committed to volunteerism. Its initial intent was to demonstrate that a primarily volunteer program could meet the need for specialized transportation and do so less expensively than if entirely paid drivers, schedulers and dispatchers were employed. We have managed to run this program successfully for 10 years and continue to exist as a testament to the fact that volunteer transportation is an effective paratransit alternative.

Volunteer Wheels provides 35,000 demand-responsive advance reservation trips a year to over 2,000 different clients countywide. Our three paid van drivers transport the wheelchair-bound disabled who need special care. Our volunteers who drive their own cars and also drive groups of ambulatory clients in our vans complete 2/3's of the entire number of trips provided each year. Our paid administrative staff supervises the operation, which requires a professional staff due to its size and complexity. The scheduling and dispatching of rides is done almost solely by volunteers.

70% of our clients are seniors. 25% are disabled. 5% are mobility disadvantaged in some way. All of our clients must be transportation-handicapped. They pay a small fare each time they ride unless it presents an economic hardship.

What follows is a letter from a man who requested our service recently. It is reproduced here because it clearly demonstrates the typical needs of our clients.

Dear Volunteer Wheels,

I have lived in this residence for 22 years and supported my own household during those years. I took an early retirement in 1972 which seemed adequate at that time although below poverty level. My annual income is now $5,364, not much money when you consider the effects of inflation over these years.

The last figures I saw on driving a car showed a yearly operating cost of $2,372.00 in the first four years of ownership. Obviously on $5,364 a year I can neither buy nor maintain my own transportation. I am sure other seniors have the same problem. I bought junk cars for a while and got burned each time.

The senior bus picks me up at my home and takes me to the meal site, plus home delivered meals on weekends and holidays, so I am well fed, but underfunded for transportation. The lack of public transportation is my main problem and getting back and forth to do my laundry has reached epidemic proportion as I do not have a washing machine or dryer and must use the launderette. One of my friends was giving me transportation until she got a job which prevents it, and I do not wish to further impose on here good nature or cause her hardship. Mostly I need someone to pick me up and my laundry and drop me off for an hour or two so I can do my laundry and grocery shopping and then pick me up and bring me back home."

Thank you

This man is asking for help for things that the rest of us take for granted. Volunteer Wheels is successful in large part because the needs of our clients are so apparent to our volunteers and fulfilling those needs in a caring way brings them a great deal of satisfaction.

While there may be some real or perceived drawbacks to operating a volunteer Paratransit Program, one obvious argument in favor of volunteer transportation is economy. Even though Volunteer Wheels offers mileage reimbursement to the drivers, we do not have to pay salaries and fringe benefits to our volunteers and this saves a great deal of money. While funds are generally available in most communities to operate a paratransit system, funding is nevertheless always an issue. Finding ways to economize is essential.

Another point in favor of volunteer transportation is that it provides an excellent volunteer opportunity, primarily for the retired sector of the community. Volunteer Wheels has volunteers who have been with the program since its inception. They know they are making a significant contribution and feel personally rewarded for their efforts. In a world of limited resources, this is an example of the community helping itself at a reduced cost to the taxpayer.

There are good reasons why communities should consider initiating a volunteer transportation program. There are also reasons why volunteer transportation might be an unrealistic undertaking. Anyone considering starting a general purpose volunteer transportation program similar to Volunteer Wheels should first consider three essential criteria for success as listed below.

1) PARENT AGENCY

There must be a parent agency or government entity willing to sponsor the program that has an unyielding commitment to volunteerism with the knowledge of good principles of volunteer recruitment and management.

2) CIVIC PRIDE AND COMMUNITY SUPPORT

There must be a sense of civic pride and community participation among the population. This is most often experienced in smaller communities with a rich historical background. The areas where we have the greatest difficulty establishing and maintaining a core of committed volunteer drivers in Sonoma County are those newer communities who have yet to develop civic pride or a historical self-identity; also areas where, for one reason or another, the citizenry is hesitant to become involved in solving local issues. One can find volunteers even in such unfriendly environments, but if such were the situation in the entire region, one would have to conclude that such a program would be too difficult to sustain because the human resources would simply not be readily enough available.

Likewise, there really should be a good-sized retirement age population base because the once-traditional volunteer (the wife who is not gainfully employed) has nearly disappeared in our new society of primarily two-income families.

3) FINANCIAL BASE

There must be a financial base; a commitment from a funding source to support the program. In California, local governments receive state sales-tax funds to provide transportation locally. The bulk of Volunteer Wheels funding comes from the County of Sonoma and the City of Santa Rosa, who receive these state funds and contract with us to provide this service. There are other funding alternatives as well, all of which should be explored. For example, we charge a small fare which accounts

for approximately 10 - 15% of our annual budget. We receive a small annual amount from United Way and we sponsor fund raising events as well as receive direct contributions from the public.

If these three criteria can be met, then you may choose to proceed organizing a volunteer transportation program. First and foremost, the system of scheduling, dispatching and effective volunteer management must be well thought out and well administered.

When Volunteer Wheels began 10 years ago, we were a fledgling organization in a brand new field. We didn't have accesss to technical help because we were one of the first in the nation to attempt such a program. Each community will vary in size, demographics etc. Therefore, it is not suitable to describe here exactly how to structure a typical volunteer transportation program. Rather each should be crafted individually to suit the nature of the community it serves. There are prototype organizations after which another can be modeled. It only makes sense to take advantage of the experience and knowledge gained by others when considering a new paratransit program in a community.

We invite anyone interested in exploring the possibility of starting a Volunteer Wheels-type program to contact us for more detailed information. Our address is Volunteer Wheels, 450 College Avenue, Santa Rosa, California 95401.

Dennis Studebaker is the Director of Volunteer Wheels. Dennis has a varied background in human service administration. In 1978 Dennis joined a federally funded transportation research project called Commuter Connection. When they project was completed he was hired to direct Volunteer Wheels, which was just beginning its fifth year. He participated in the expansion of the program from a city-wide to a county-wide program.

3.0 MASS TRANSPORTATION AND SPECIALIZED SERVICE

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Air Travel

Accessible Fixed Route and Specialized Services

Advocacy and Public Awareness

EFFECTIVE TAXICAB TRANSPORTATION FOR THE DISABLED

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EFFECTIVE TAXICAB TRANSPORTATION FOR THE DISABLED

BY

MICHEL WILSON

ADMINISTRATIVE DIRECTOR

TRANSPORT ADAPTE DU QUEBEC METRO INC.

(QUEBEC, CANADA)

A few years ago, public transportation by cab of disabled persons was unheard of in the Province of Quebec. Taxicab drivers were avoiding such clientele. But the whole situation changed in 1982.

That year, Transport Adapté du Québec Métro Inc., a subsidiary of the Quebec City Transit Commission providing transportation for the disabled, introduced the use of taxicabs. Today, 57 % of the users such as the blind, mentally deficient and the handicapped in manual wheelchairs, are transported by cab. Specialized minibuses are mostly used to assure transportation of clients with motorized wheelchairs. With 1 100 persons admitted to the service, there was a total of 95 000 trips in 1985. Trip destinations were as follows: 38 % for leisure, 28 % for work, 24 % for services and 10 % for studies.

Our Corporation's budget is subsidized by the Quebec Ministry of Transport at 75 % and the participating municipalities share the remaining 25 % with the users'fare (representing approximately 5 %).

In accordance with the eligibility criterias in effect in the Province, the admission committee, taking in account the user's requirements, assigns the latter to the least specialized transportation mode.

The introduction of taxicabs resulted in improving both services and costs. Tangible improvements were rapidly noticed:

1. an increased number of vehicles became available;
2. the advanced reservation notice was reduced from twenty-four hours to eight hours;
3. the passenger's average travel time was reduced;
4. important hour changes imposed to the user were minimized;
5. transportation impossibilities were brought down to zero for the last four years;
6. the user is travelling throughout the city with greater ease;
7. the dispatchers benefit of an improved flexibility to assign trips;

In 1981, T.A.Q.M. was using eleven (11) adapted minibuses and the cost per person transported was 18 \$. Since then, the average cost (combining trips made by cab and minibuses) was lowered to 17,54 \$ in 1982, 14,27 \$ in 1983, 13 \$ in 1984, and 12,82 \$ in 1985. These figures include all operating costs. We now operate seven minibuses and approximately two hundred taxicabs are involved in public transportation for disabled in the greater Quebec City area.

Undoubtedly, there are still a few problems related to the use of taxicabs. Users mention premature wear or occasional damages to wheelchairs, the physical effort required to transfer from chair to seat, wet or cold wheelchairs placed in trunks of cars. Our dispatchers comment on the difficulty to obtain cars on peak hours or bad weather,delays due to cab drivers choosing trips, and an increase of "no-shows" by the users.

T.A.Q.M. was the first to introduce taxicabs as a public means of transportation for the disabled in the Province of Quebec. In August of 1985, the Quebec Ministry of Transport adopted new regulations to broaden the use of taxis to transport disabled persons. For instance, the use of small adapted minivans is now possible. Such vehicles will provide transportation for wheelchair users without any transfer from the chair to the seat. The new regulations also compel the driver to bring assistance to a passenger who, for reasons of age, handicap or an apparent state of health, obviously needs help. Furthermore, a driver cannot refuse trips, except if the distance exceeds fifty kilometers.

These measures will help enlarge the utilization of taxicabs and our Corporation wants to go ahead with all new possibilities to promote such means of transportation. It has proven itself to be effective and less costly, when compared to conventional adapted vehicles. The increased use of taxis has permitted the demand for specialized transportation to be met more adequately than ever and both the operator and the users appreciate it. This explains why the taxicab is now an important part of the public transportation systems for the disabled throughout Canada and abroad.

COMPARISONS 1982 - 1985

	1982	1983	1984	1985
Number of passengers	65 982	79 714	87 941	94 694
Total spent (Canadian $)	1 157 385 $	1 137 824 $	1 142 356 $	1 214 687 $
Average cost per passenger	17.54 $	14.27 $	13.00 $	12.82 $
Adapted vehicule: cost per passenger	22.14 $	17.91 $	16.08 $	16.02 $
Taxi: cost per passenger	15.18 $	12.22 $	11.01 $	10.41 $

A TRANSPORTATION DEMONSTRATION PROJECT FOR SENIORS: AN OVERVIEW OF ITS SYSTEMS, TECHNOLOGY AND VIABILITY

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A TRANSPORTATION DEMONSTRATION PROJECT FOR SENIORS: AN OVERVIEW OF ITS SYSTEMS, TECHNOLOGY AND VIABILITY

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Introduction

The transportation needs of senior citizens have been identified in a number of studies. While some seniors are able to sustain mobility within their community, many others lack access to suitable transportation. Especially difficult is the situation of those who maintain their own homes and live self-sufficiently, but are not close to an existing bus route or do not operate their own vehicles. Sometimes, even those near bus routes find normal public transit too strenuous. During cold weather these seniors are liable to become isolated from the community and travel only when absolutely necessary by taxi cabs at relatively high cost. Safe movement is a further concern of senior citizens whose health has become less robust with age.

The isolation of seniors, for health and economic reasons, is a serious matter not only for the individuals affected but also for the community at large. Such isolation can only diminish the strength of a community. Improved mobility, with the expectation of health improvement, should reduce the need for health care institutional space and medical service. It also offers better participation of seniors in the social, cultural and commercial activity of the community. Public transit, even at sharply reduced fares, does not appear to offer a sufficient mobility solution. New approaches to transportation are needed. This paper examines an innovative project undertaken by two community service organizations in Winnipeg with the support of the Federal Government.

The two community service organizations are the Age and Opportunity Centre of Winnipeg, Inc., and the Fort Garry Branch of the Royal Canadian Legion. These organizations have been concerned about the mobility problems of seniors for some time as have a number of people in government. After consultation with the service organizations, Transport Minister Lloyd Axworthy announced a Transportation Demonstration Project for Seniors on February 1, 1984. The Project was designed to operate in two adjacent areas in Winnipeg on a two-year basis. An initial grant of $90,000 was made; total funding of the two service organizations which undertook to operate the Project was $573,000. Mr. Axworthy's successor as Transport Minister, Mr. Don Mazankowski, continued support of the Project to its completion on March 31, 1986.

The objectives of the Project were:

1. The provision of increased accessibility to the community for seniors by means of transportation.

2. The development of an innovative transportation system suitable for seniors by means of progressive methods of system operation and the use of a new type of vehicle, the Orion II.

3. The operation of the project through two community groups which are sensitive to, and provide for the participation of, seniors in the development of the project.

4. The development of a transportation system which is economical and effective in its operation.

The Special Transport Service developed its own objectives in response to their own policies. They are fully compatible with the objectives stated above.

The task undertaken in the Demonstration Project was difficult but important both for seniors and for transit development. Increased transit use is not amenable to large increases through fare reduction. Even a zero fare is likely to achive only limited results.(2) Success of the Project required a shift forward in the basic demand for service among potential users. Such an achievement required the coordinated effort of system personnel, the use of new technology, and the participation of members of the user population.

The System

Operation of the Demonstration Project was conducted by the two operating units, the Special Transport Service and the Fort Garry Legion Transportation Project, on an independent basis with their own sub-systems. The designated areas for users were adjacent. The Special Transport Service drew its users from the R3L and R3M postal districts of Winnipeg in an area known as Fort Rouge. Users of the service provided by the Fort Garry Legion Transportation Project were located in Fort Garry and St. Norbert. The general location of these areas is south of the downtown area of Winnipeg with a north to south axis running through Fort Rouge, Fort Garry and St. Norbert successively.

Organization of the operating units was on a simple functional basis. Each had a general manager with a permanent staff of two drivers and a dispatcher. The Special Transport Service used a substantial number of volunteers who served as drivers of rental cars, escorts, and interviewers. These volunteers also assisted in the dispatch function. The Fort Garry Legion Transportation Project used volunteers for registration work and employed their dispatcher for clerical duties. Temporary summer student help was also used to augment planning and operations of both operating units. The Special Transport Service obtained specialist services to conduct internal evaluation.

Both operating units operated under the aegis of committees related to their parent organizations. To provide for a more distinct organizational basis for future development, and to provide for an independent committee or board, the Special Transport Service moved to an incorporated status in 1985. Both operating units were responsible to Transport Canada on a contractual basis. Independent performance monitoring was provided to Transport Canada supplemented by liaison work and advice to the operating units when appropriate.

In autumn of 1985 the Fort Garry Legion Transportation Project joined with the Special Transport Service in the establishment of a joint committee to provide for the best exploitation of opportunities for the long term

success of their transport service for seniors following the anticipated end of the Demonstration Project.

The principal vehicles used were the Orion II, an innovative small bus which is discussed subsequently, and vans with wheelchair capacity. Considerable use of rental vehicles driven by volunteers was a feature of the S.T.S. operation.

The extremely important work of development of a user population was initiated by the Special Transport Service. Registration for use of the system was carried out on the basis of a door-to-door survey of the R3L area with random sampling of the R3M area evaluated from February to September, 1984. Registration reached a level of about 1,600 by September. "Call backs" continued in subsequent weeks.

The Fort Garry Legion Transportation Project began operation at a later date, August 23, 1984. Registration was invited by means of posters in frequently used stores, by distribution of flyers, and by publicity through local newspapers. Registrations reached 800 by the end of 1984. The registration figure was approximately doubled in the summer of 1985 through the efforts of student summer help and volunteers. Table 1 illustrates the pattern of registration development.

Table 1

FORT GARRY LEGION TRANSPORT PROJECT REGISTRATION

August	23	230	March	31	959
September	30	380	April	30	1009
October	31	531	May	31	1220
November	31	716	June	30	1372
December	31	802	July	31	1532
January	31	865	August	31	1650
February	28	925	September	30	1701

Source: F.G.L.T.P. Records

Operation of service by the S.T.S. was phased in. It began in the R3L (postal code) area with service directed to a small area in the south-east corner. Service was then developed on a slower basis, because of service system limitations, through the R3M area. Service was on a telephone request basis with a lead-time required. A scheduled service was begun in August, 1984, on a weekly basis. Again telephone request was used and service was provided to medical, shopping, and entertainment areas. Service was adjusted to perceived user need during its time of operation.,

The Fort Garry Legion Transportation Project was originally to operate with a fixed route system with diversions to homes but the system actually instituted was on a pre-booking basis. The system scheduled service in relation to demand in order to achieve maximum user satisfaction and satisfactory vehicle load factors.

The Special Transport System planned to computerize their dispatch on the basis of a program written for the system. The Fort Garry Legion Transportation Project investigated the possibility of computerization of scheduling, record keeping, and accounting. Neither operation group introduced computers into operation. It should not be inferred that computers do not offer convenience and productivity improvement. Steady delivery of service without the risk of computer system introduction problems and cost considerations led to the decisions to defer computer use.

Project operation was aided by the use of two-way portable transistorized radios to provide communication between dispatchers and the drivers. Use of these radios made an important contribution to service efficiency.

Orion II maintenance initially was provided by two local service operations. Transitech Industries was used by the Special Transport Service while the Fort Garry Legion Transportation Project used De Foort Motors. Subsequently it was decided to rationalize maintenance through De Foort Motors despite the fact that the S.T.S. had been satisfied with Transitech's performance.

Service by the S.T.S. placed strong emphasis on its volunteer component. Development of volunteer participation had reached a mature phase by the early part of 1985 and Volunteer Recognition Week was held from April 15 to 21. The S.T.S. revealed that volunteer drivers had provided 809 of the 10,000 trips made. In the office, volunteer assistance had contributed more than 1,200 hours of work answering telephones, filing, keeping records, scheduling and typing. Volunteers had conducted 180 interviews of potential users and had provided escorts to 104 persons.

Pricing of service in the Project was designed to preserve moderate fare levels operating at somewhat of a premium above standard transit fares. The intent was to attract users by service rather than by fares. The fares were set to reflect to some degree the special service provided but to avoid charges which would counteract efforts to improve mobility among those with a low ability to pay. Fare development is shown in Table 2.

The Fort Garry Legion Transportation Project's pricing system was similar in principle to that used by the S.T.S. but different in some details.

The character of user response to the service provided by the Project is shown by statistics accumulated on trip types. For the duration of the project the S.T.S. records reveal that slightly over 40% of user trips were medical, about 30% were for shopping and almost 20% were for social and recreational purposes. The Fort Garry Legion Transportation Project records for their first year of operation show a somewhat different pattern. Almost half (48%) of the trips were for shopping, 26% were for medical purposes while 16% were used for social activity.

Operation of a transit service with high service standards with such small vehicle fleets put heavy demands on the operating units. However, a high standard of performance was achieved. User response was exceptionally favourable and a substantial base of community support for the Project was developed.

Table 2

SPECIAL TRANSPORT SERVICE

FARE LEVELS AND STRUCTURES

May, 1984 - March, 1985	\$0.75 one-way \$7.00 for 10-trip pass
April 1985 - August, 1985	\$1.00 one-way \$9.00 for 10-trip pass
September, 1985 - March 1986	\$1.00 one-way with 3 kms. of S.T.S. office \$1.00 eastern zone fare from 3 km. limit to city boundary. A further \$1.00 zone fare to Bird's Hill Park. Excursion rates at \$15.00 per hour with \$45.00 maximum (advance deposit of \$45.00 refundable with two working days notice before trip date).

Source: S.T.S. records

<u>The Orion II</u>

Three Orion IIs were used in the Demonstration Project. All were 25' versions with provision for a wheelchair in addition to 19 seats. The Special Transport Service took delivery of the Orion II prototype in June, 1984. This prototype bus was transferred to the Fort Garry Legion Transportation Project when the S.T.S. took delivery of an Orion II production vehicle in November, 1984. The Fort Garry Legion Transportation Project acquired a production vehicle in February, 1985, and returned the prototype to Ontario Bus Industries. Effectively, from November, 1984, each operating unit had one Orion II. The Orion IIs were operated in conjunction with smaller vehicles. The Special Transport Service used a Dodge Van with a capacity of 7 seats in 1974. In September, 1984, the S.T.S. introduced a new Ford Handi-Van with a capacity of 8 seats and 2 wheelchairs. Rental cars, and occasionally, taxis were also used by the S.T.S. The Fort Garry Legion Transportation Project acquired a Dodge Van (1979) with a capacity of 11 seats in June, 1984. Near the end of 1984 a Chevrolet Van (1979), a lift van with a capacity of 7 seats and a wheelchair, was added.

The Orion II is a significant technological innovation in bus transportation. It is manufactured by Ontario Bus Industries, Inc. where two years were spent in market research, and design and development of a prototype vehicle. Mr. Don Sheardown, Company president had been interested in bus transportation for the handicapped for several years. Mr. Mike Marlatt was recruited to be project engineer, heading a development team of six engineers and six shop personnel. Gidman Design Associates, a firm which had designed streetcars for the Toronto Transit Commission, contributed conceptual body

design to the project. The prototype required an investment of $2.2 million; over $1.3 million was provided through the Enterprise Development Program of the federal Ministry of Industry, Trade, and Commerce. Subsequently the Orion II was tested at the high-technology Motor Vehicle Test Centre of Transport Canada near Montreal. Federal government engineers, private testing laboratory engineers, and the O.B.I. development group, put the Orion II through a rigorous and wide-ranging set of tests. An independent engineering report gave the vehicle an excellent rating in terms of vehicle performance, favourable driver and passenger acceptance, and complete freedom from operational problems. The development of the Orion II is a striking and successful case of Canadian government and enterprise interaction.

The specifications of the 25' version of the Orion II are given on the following page. Certain design features are of special value to users. An entirely flat floor is achieved through the use of a front-wheel drive design and the elimination of a back axle by use of independently suspended rear wheels. The Orion II's air-bag suspension system deflates to lower the floor height by 4" (102 mm) in the front and by over 8" (204 mm) at the rear. This means that the bus can provide passenger access at curb level. If a wheelchair is in use a ramp slides out to facilitate access. No steps or lifts are involved. Wheelchair riders have "random access", i.e. they can enter or exit the vehicle, by either the front or rear door, without disturbing the other passengers. When on the bus, the wheelchair faces forward as do the seats of adjacent passengers.

Maintenance and overhaul of the Orion II is facilitated by its design, which incorporates a power train module. This contains the engine and cooling system, the transmission, the front-wheel drive assembly, suspension, and the steering mechanism. The module detaches from the bus in less than an hour and can be re-installed in the same length of time. With a fleet of Orion IIs, a spare module would reduce turn-around time. Another design feature which simplifies maintenance service is the interchangeability of the complete wheel assembly. These assemblies comprise the wheel, tire, drum-brake assembly, hub and seal and can be switched from one wheel position to any other.

The Demonstration Project rider response to the Orion II has been extremely favourable. The ease of entry and exit and general comfort and convenience have been frequently noted. Further, the large, low windows give the riders a sense of being in the community while in transit. The bus also seems to engender a sense of community among the passengers while they travel.

Driver response has also been positive. The Orion II is easy to drive and its performance in terms of acceleration and maneuverability has been excellent. The interior design of the bus facilitates a friendly relationship between the driver and passengers.

Under the severe test of Winnipeg winter conditions some interior heating problems were experienced. These appear to have been solved through augmented heating. Some reduction in interior noise would be beneficial as would the ducting of exhaust gases to the rear and improved cold weather starting. These three points are receiving design attention.

Maintenance has been satisfactory to the Fort Garry Legion Transportation Project but the Special Transport Service has had some vexatious problems. It

Orion II

Vehicle Specifications

Length:	25' 11" (7899 mm)	Width:	96" (2438 mm)
Height:	100" (2540 mm)	GVW:	18,500 lb (8392 kg)

Engine:	Detroit Diesel; 8.2 litre; 130 HP (97 kw) @ 2800 RPM
Transmission:	Automatic; Allison AT545
Side Door:	Adjacent driver; 36" x 77" (914 mm x 1956 mm)
Rear Door:	Rear face of bus; 40" x 77" (1016 mm x 1956 mm)
Seating Capacity:	26 seated maximum plus driver OR a combination of fewer seats plus wheelchairs
Body Structure:	Stainless steel integrated structure
Interior Panels:	Stainless steel with removable aluminum and fibreglass
Interior:	RCA Rubber floor and melamine panelling
Heating System:	80,000 BTU (20,161 KCal) combined front and rear
Air Conditioning:	45,000 BTU (11,341 KCal) or fresh air ventilation
Floor Height: "Normal Ride"	12" from ground (305 mm)
Vehicle Propulsion:	Front wheel drive helical reduction
Suspension: Front	Full air, beam axle
Rear	Full air, independent trailing arm
Steering:	Integral power
Wheel Cuts:	48°
Source:	Ontario Bus Industries Inc.

is hard to be precise about the source of these problems. A more difficult development of a maintenance arrangement may have contributed. It may be that the Orion II used by the S.T.S. had a somewhat different engine, suited to California requirements, which led to some service frustrations. It may have simply been bad luck or some errors in maintenance. It is appropriate to note that new vehicles, especially those of novel design, experience problems during their early period of use. There is no reason, on balance, to conclude that the Orion II should not have a satisfactory maintenance record in regular service. However, it is appropriate to note the stress experienced by the S.T.S. because of maintenance problems with the bus.

In terms of system suitability of the Orion II it appears that the needs of seniors are best served by a combination of bus and van usage. The vans are more useful for individual service while the comparative advantage of the bus appears when several persons or a group is involved in travel. Occasionally, the bus can have an access problem because of a low clearance entrance to a building which can be avoided by a smaller vehicle. However, the Orion II is extremely compact for a vehicle of its capacity.

In general, the Orion II's use in the Demonstration Project is most encouraging. Its performance shows that it offers much improved transportation conditions for seniors and handicapped persons.

<u>Financial Viability</u>

How viable should a transport system be on the basis of user fees alone? From the standpoint of economic theory a serious economic analysis of economics of scale in transit in a U.S. urban area reached the fundamental conclusion that a subsidy of roughly 50% to 60% of the costs borne by the transit authority was justified.(3) Further support is given by other researchers to public transit subsidization by income distribution arguments and by policies directed towards relief of road congestion.(4)

On a practical basis reference can be made by using Winnipeg Transit cost-recovery figures as standards.(5) The following are cost-recovery figures:

Table 3

PUBLIC TRANSIT COST RECOVERY

Winnipeg Transit	50%
Winnipeg Transit Threshold figure for possible route abandonment for a feeder line	20%
Handi-Transit (operated by the City for handicapped persons)	2-3%

Source: Winnipeg Transit

It is worth noting that Winnipeg Transit adult fares are 80 cents and the fare for seniors is 30 cents. Handi-Transit fares and those charged in the Demonstration Project are generally in line with each other.

A financial viability analysis of the Demonstration Project is presented on pages 11 and 12. Two warnings are in order. First, the basic data were not designed with this analysis in mind and the problems of conversion of the data to the tables presented are serious. Second, the viability ratios give a Project view of viability. Comparison between the operating units is inappropriate for several reasons.

However, the viability analysis can be relied upon to give a good indication of Project performance. Calculation of average quarterly viability percentages over time is not a meaningful statistical exercise, given that there is a developmental experience, or learning curve, running through the period under review. Bearing in mind that there does not seem to be marked seasonalitiy in the use of the service, and allowing for the fare increases presented earlier, the viability percentage appears to be on a firm footing at the 10% level under the operating methods used in the later stages of the Project.

This viability performance is amenable to further improvement but even as it stands, it is an impressive achievement for a system which offers such a high quality of user service.

<u>Conclusion</u>

The principal findings in this paper are:

1. It was possible to build and retain a substantial constituency of users.

2. Response of users to the system was very favourable.

3. Recruitment of suitable staff and part-time assistance that met the specialized needs of the Project was successfully achieved.

4. The Orion II had very good user acceptance and was a useful vehicle despite some development problems that required attention. The vans provided valuable flexibility.

5. Computerization of dispatch has interesting potential but was judged impractical for introduction during the life of the project.

6. Communication equipment provided important system support.

7. The viability of the service operation was much better than that of a handi-transit system but fell short of that of conventional transit systsems, even on lower density routes. It was sufficiently good to offer promise of continuing support for its role in public transit.

It is gratifying to note that the transportation service developed in this Demonstration Project continues to operate on the basis of a merged operation. The service is now known as the Seniors Transport Service, Incorporated.

References

1. Professor of Economics and Transport Canada performance evaluator for the Demonstration Project.

2. Baum, H.J. (1973), "Free Public Transit", Journal of Transport Economics and Policy (January).

3. Mohring, H. (1972), "Optimization and Scale Economies in Urban Bus Transportation", American Economic Review, 62 (September).

4. For a useful Canadian work on urban transportation economics, see Frankena, M.W. (1979), Urban Transportation Economics, Butterworth and Co. (Canada) Ltd., Toronto, Ontario.

5. Much basic information on Canadian transit plus bibliography is available in Canadian Transit Association and the Roads and Transportation Association of Canada (1986), Canadian Transit Handbook, Toronto, Ontario.

SPECIAL TRANSPORT SERVICE

VIABILITY ANALYSIS

FOR THE PERIOD JANUARY 1, 1985 - MARCH 31, 1986

	Jan. '85 Mar. '85	Apr. '85 June '85	July '85 Sep. '85	Oct. '85 Dec. '85	Jan. '86 Mar. '86
Vehicle & Dispatch Costs					
Salaries & benefits	$10,815	$11,933	$16,250	$14,501	$14,758
Lease expenses (Orion II)	6,450	6,450	6,450	6,450	6,450
Depreciation (vans)	2,586	2,586	2,586	2,586	1,810
Vehicle rental	1,178	201	788	366	393
Vehicle storage	1,097	1,050	1,812	598	1,427
Telephone dispatch system	2,590	489	719	903	711
Insurance	784	784	784	784	784
Gas, oil & maintenance	2,895	1,148	3,560	1,509	2,561
Mileage costs	277	481	766	949	1,091
Volunteer recognition	125	769	412	102	589
Vehicle signage, tickets and printing	76	187	264	10	175
Miscellaneous	543	418	371	1,005	1,589
Total Vehicle and Dispatch Costs	$29,416	$26,496	$34,762	$29,763	$32,338
Administration and Office Costs					
Salaries & benefits	$ 5,638	$ 6,689	$ 5,733	$ 6,880	$ 8,645
Office rent, utilities and maintenance	1,268	1,188	2,073	1,137	1,293
Equipment, supplies and outreach	755	487	720	903	711
Professional services	3,000	3,000	3,000	3,000	3,000
Total Administration and Office Costs	$10,661	$11,364	$11,526	$11,920	$13,649
TOTAL COSTS (a)	$40,077	$37,860	$46,288	$41,683	$45,987
USER FEES (b)	$ 2,563	$ 2,909	$ 4,019	$ 4,529	$ 3,314
VIABILITY % (b:a%)	6.40%	7.68%	8.68%	10.87%	7.21%

1. Source: Special Transport Service records (unaudited).
2. Orion II lease charges are pro-rated on a quarterly basis.
3. Van depreciation is 30% of net asset value annually and pro-rated quarterly.
4. Insurance costs are aggregated and pro-rated quarterly.
5. Salaries for summer assistance and internal evaluation costs are excluded.
6. January, 1985, user fees are estimated from user trip data.

FORT GARRY LEGION TRANSPORTATION PROJECT

VIABILITY ANALYSIS

FOR THE PERIOD JANUARY 1, 1985 - MARCH 31, 1986

	Jan. '85 Mar. '85	Apr. '85 June '85	July '85 Sep. '85	Oct. '85 Dec. '85	Jan. '86 Mar. '86
Vehicle Costs					
Salaries & benefits	$ 8,610	$10,220	$11,190	$12,540	$12,960
Vehicle lease (Orion II)	5,820	5,820	5,820	5,820	5,820
Depreciation (vans)	870	870	1,690	2,010	1,830
Garage rent	630	1,210	750	750	750
Insurance	842	842	842	842	842
Fuel and Oil	2,230	1,830	2,340	2,750	2,980
Repairs & maintenance	2,690	680	980	670	630
Total Vehicle Costs	$21,692	$21,472	$23,612	$25,382	$25,812
Administration & Office Costs					
Salaries & benefits	$12,320	$13,330	$11,910	$13,180	$15,650
Rent	2,175	2,215	2,295	2,295	2,295
Depreciation	570	570	630	630	630
Advertising & promotion	630	860	150	50	0
General office	2,370	1,530	2,910	1,370	3,640
Stationery & supplies	490	1,070	110	520	340
Professional fees	1,874	1,874	1,874	1,874	1,874
Total Administration and Office Costs	$20,429	$21,449	$19,879	$19,919	$24,429
TOTAL COSTS (a)	$42,121	$42,921	$43,491	$45,301	$50,241
USER FEES (b)	$ 2,118	$ 2,652	$ 3,357	$ 4,678	$ 5,123
VIABILITY % (b:a%)	5.03%	6.18%	7.72%	10.33%	10.20%

1. Source: Fort Garry Legion Transportation Project records (unaudited).
2. Orion II lease charges are pro-rated on a quarterly basis.
3. Van depreciation is 30% of net asset value annually and pro-rated quarterly.
4. Insurance costs are aggregated and pro-rated quarterly.
5. General Office costs include office, telephone, bank and interest charges.
6. Note that dispatcher salaries and benefits and telephone costs are listed under Administration and Office Costs for the Fort Garry Legion Transportation Project while they are listed under Vehicle Costs for the Special Transport Service.

SPECIAL TRANSPORT SERVICE DEMONSTRATION:

AN INNOVATIVE RESPONSE TO THE MOBILITY NEEDS OF THE ELDERLY

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1.0 INTRODUCTION

Special Transport Service (STS) was a 27-month project of the Age and Opportunity Centre, Inc. (AOC) designed to demonstrate delivery of a community-based paratransit service for mobility-handicapped elderly persons in a densely populated part of Winnipeg's inner city. Under a funding agreement with the federal Department of Transport (DOT), STS also tested the Orion II, a specially designed paratransit vehicle produced by Ontario Bus Industries.

The project was a response to recurring problems of accessibility and suitability faced by elderly persons who attempted to use conventional transportation services and vehicles. It sought to combine the efforts of salaried staff and volunteers in the implementation of a model with the following elements:

- social as well as service efficiency and effectiveness objectives
- door-to-door transportation (demand responsive, scheduled and subscription-type services)
- coordination of several vehicle types (bus, vans, rental and private cars, taxis)
- a driver complement of salaried staff and volunteers, supplemented by volunteer escorts
- minimal user and trip-purpose criteria
- community involvement and support in provision and maintenance of the service.

STS operated in parts of the Fort Rouge, Crescentwood and River Heights communities in central Winnipeg. Several factors influenced this selection:

- the number of persons aged 60 years and over (nearly 25 per cent of the area's total population)

- density of the population (densities in some subdistricts of the service area are among the highest in the city due to a concentration of high-rise apartment buildings including several elderly persons' housing projects)

- proximity to the central business district and key medical facilities

- the perceived strength of existing community services, facilities and organizations which, it was thought, could be used to support and complement the demonstration

- diversity of housing types, income and sociocultural groups.

2.0 IMPLEMENTATION OF STS

STS's first year of operation was dominated by:

- building the service, especially in terms of increasing registrants and ridership; volunteer recruitment and development; and committee (board) recruitment and development(see Chart 1)

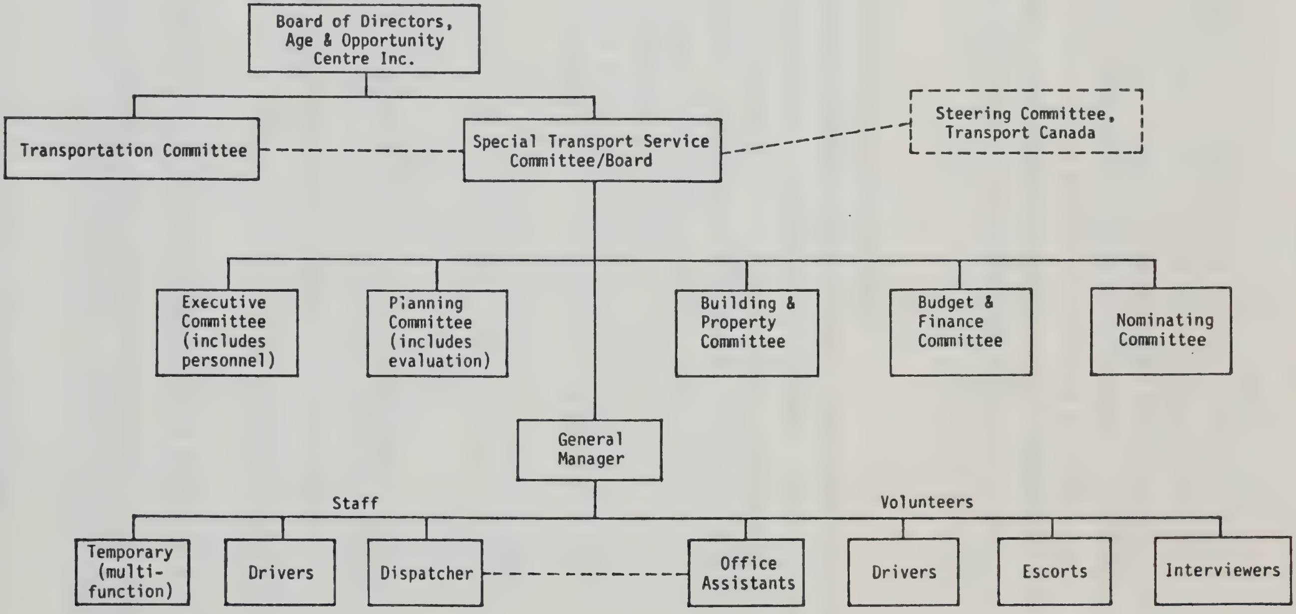
- experimentation with services, schedules, policies, and means of delivery

- tending to regulatory, legal, administrative, mechanical and other support service details.

Management, salaried staff and line volunteers for the most part were learning on-the-job. Their focus was on the daily details of establishing and improving service. Delays in receipt of their Orion II, and mechanical problems with both it and the prototype originally loaned to the project, were particularly onerous because they absorbed a considerable amount of management/staff time and affected the efforts of the fledgling project to establish credibility and trust with its registrants/users. Efforts to undertake long-term planning, fund-raising and community outreach were not carried through in a sustained or consistent way in the first year of operation.

CHART 1

STS Organizational Structure as of April, 1985



<u>SOURCE:</u>

IUS.

The second year of the demonstration was marked by organizational imperatives:

- development of a constitution and articles of incorporation in preparation for establishment of an entity separate from AOC in the post-demonstration period beginning April 1, 1986

- a major change in STS Committee structure and membership in April 1985

- intensive efforts beginning in mid 1985 to obtain funding for the post-demonstration period, including formation of a joint committee with the Fort Garry Legion for this purpose

- in early 1986, negotiations to merge the two projects as a condition of receiving funding for a further demonstration period (to March 31, 1987).

Efforts to build and modify STS in operational terms continued during the latter 12 months of the project but the intensity of these activities was not as great as in the first part of the project. There were some major policy decisions regarding fare levels and greater structuring of demand for service but, in general, STS became more routine in its daily operations. Uncertainty about continuation of the service beyond March 1986, coupled with a perception within STS that the project was operating at capacity, led to a decision to not actively pursue new registrants/users, although registration continued as requests were made to the project. 'Community development' became fund-raising and the focus mainly was on actors (service clubs, governments, other potential funding sources) external to the service area.

Some 26,300 passenger trips were made by March 31, 1986 when STS merged with a second DOT-funded demonstration project operated by the Royal Canadian Legion's Fort Garry Branch in suburban neighbourhoods near the STS target area. The merged organization, called the Seniors Transport Service Inc., obtained joint funding from the federal, provincial and city governments to operate for one further demonstration year on an integrated basis in the same neighbourhoods served previously.

3.0 STS EXPERIENCE 1984-86

STS sought to demonstrate three orientations: social good, cost effectiveness and community development. The first two were most consistently pursued and were the basis for a creative tension underlying the establishment and evolution of the project. This tension incorporated the following perspectives:

1. STS was designed to demonstrate the unserved transportation needs of elderly persons and how to provide a service which would meet those needs efficiently and effectively. Social good and community development would be important byproducts but not the main ends of the project. Indeed, there was some question as to whether a transportation project was the appropriate vehicle to try to achieve the latter, or whether existing services were more appropriate and effective given that elderly persons could have access to them.

2. STS was designed to be more than a transportation service. Social good and community development were essential, along with cost effectiveness, in establishing an alternative model -- in particular, to support the community-based, decentralized approach to service and to have long-term impact on the kinds of social infrastructure developed to support independent living by elderly persons in their communities.

Table 1 and 2 provide a statistical overview of the STS project.

STS evolved four basic types of service:

- Demand-responsive bookings largely were accommodated through use of volunteer drivers, and combining individual trip requests with STS's scheduled services via the Orion or Ford. Users were encouraged to time their trips to be compatible with STS's service patterns.

- Scheduled shopping and medical trips were offered weekly. Morning medical trips went to a major, multi-unit health complex, the Health Sciences Centre, via downtown medical clinics. Trips also were made to St. Boniface Hospital as required. Shopping schedules were circulated with STS's monthly bulletin. They were determined by the dispatcher and general manager based on their analysis of user demand.

TABLE 1

Overview of STS Project, January 1984 - March 1986

Registrants

Number on File - March 31, 1986	1,576	
Number who used service at least once	775	(49.2%)
Number who never used STS	801	(50.8%)
Number of active users - March 31, 1986	276	

Usage

Total number of passenger trips	26,301
By trip type:	
medical	41.6%
shopping	30.6
social/recreational	18.2
other	9.6

Staffing

a) Salaried Staff
- 1 general manager
- 1 dispatcher
- 2 drivers
- temporary staff including relief drivers

b) Line Volunteers

Number of active volunteers - March 31, 1986	22
Total number of volunteer hours - 1984-86	4,050

Vehicles

- 1 Orion II bus, 20 passengers
- 1 Ford Handivan, 10 passengers
- private and rental cars
- occasional use of taxicabs

Finances

Revenues	$399,209	
Expenditures	400,523	
Deficit	$ 1,314	(unaudited - March 31, 1986)
Gross Cost per Passenger Trip	$11.91	

SOURCE:

IUS

TABLE 2

STS Users in Relation to the Mobility Handicapped Elderly Population in the Service Area (1)

	As of May 31, 1985	As of December 31, 1985	As of March 31, 1986
Active Users	575	449	276
Active Users who are Mobility Disadvantaged	410 (71%)	303 (67.5%)	216 (78.3%)
% of Mobility Handicapped Elderly Population in Service Area Served by STS (2)	19%	14%	10%

NOTES:

1. Registrants who had used STS in the previous 60 days.
2. Based on June 1, 1985 population estimates by the Manitoba Health Services Commission.

SOURCE:

IUS.

- Special events were promoted, including a popular Trip-of-the-Week feature scheduled by STS as well as concerts, theatre and other activities scheduled by other organizations.

- A subscription-type service evolved for those users who had regular trip cycles. Concerns arose, however, about the inflexibility this service introduced to scheduling, especially as use of this option increased. In particular, it was felt that occasional users were placed at a disadvantage.

Table 3 outlines the fee structure while Table 4 presents the passenger trips by vehicle type. STS used several types of vehicles including private cars, rented cars and taxis. The majority of trips were provided with the core vehicles - Orion II bus and Ford van:

1. The 1984 Orion II bus was under a lease-purchase agreement from the manufacturer, Ontario Bus Industries of Mississauga, Ontario. The vehicle accommodated a maximum of 20 passengers (19 ambulatory and one wheelchair) with decreasing maximum capacity as the number of wheelchair passengers increased. Low-floor design and an air bag suspension facilitated easy access and egress by ambulatory and wheelchair passengers. The bus mainly was used for higher-volume group trips. It lacked the maneuverability of a smaller vehicle in traffic, on narrow residential streets, and for pick-ups at some apartment block entrance-ways in the service area. In general, users expressed satisfaction with this and all other STS vehicles. However, addition of the Orion to the demonstration contributed to a number of unanticipated operational problems, and the downtime associated with the bus affected scheduling/dispatching and service credibility, which were areas about which some user dissatisfaction arose.

   From STS's perspective, there were two main problems with the Orion:

   - The efficiency imperatives of a vehicle of this capacity required more group, many-to-few-or-one, or few-to-few-or-one trips, rather than the many-to-many-type service originally envisioned. There were mixed views on the benefits or weaknesses of this. It led to some successful services such as shopping trips and the trip-of-the week, and it provided the capacity for excursions. These events provided some of the socialization opportunities STS wished to make available to users, but it also drew the project into providing more service to destinations outside Fort Rouge and River Heights than originally intended. In general, STS began quite early in the

TABLE 3

STS Fee Structure and Changes

Period in Effect	Fees
May 1984 - March 1985	\$.75/one-way trip (cash) \$7.00 per 10-trip pass
April 1985 - August 1985	\$1.00/one-way trip (cash) \$9.00 per 10-trip pass
September 1985 - March 1986	\$1.00/one-way trip within a three-kilometre radius of the STS office additional \$1.00 zone fare beyond this radius to the city's boundaries a second zone fare \$1.00 beyond the city's boundaries to Bird's Hill Park introduction of excursion rates at \$15/hour with a minimum charge of \$45 and a non-refundable deposit of \$45 required unless cancellation occurred up to two working days before the date of the trip

SOURCE:

From STS records.

TABLE 4

STS Passenger Trips by Vehicle
September 1984 - March 1986 (1)

Vehicle	Number of Passenger Trips		By Driver		
	Total for Vehicles	% of All Trips	STS	Volunteer	Other
Orion (Prototype and leased buses)	11,282	48.6	11,282	-	-
Ford	7,486	32.2	6,887	599	-
Dodge	842	3.6	772	70	-
Volunteer Cars[2]	2,280	9.8	-	2,280	-
Rented Vehicles	756	3.3	691	65	-
Taxis	379	1.6	-	-	379
Other	205	0.9	198	7	-
Total	23,230	100.0	19,830	3,021[3]	379

NOTES AND SOURCE:

1. The data were taken from daily summaries recorded by STS in a log book. They have not been adjusted for discrepancies in total number of passenger trips reported for Weeks 19-98 (23,346) or total number of trips by type (23,255). Prior to Week 19, data were summarized by trips rather than by passenger trips and thus were not used in the above table.

2. During the early part of the period volunteer-driver trips in STS vehicles were not necessarily summarized separately; thus, the totals may be understated somewhat.

3. Overall, volunteer drivers provided 13 per cent of STS's passenger trips in this period. Data for volunteer drivers of STS vehicles during the early parts of the period reflect use of STS vans by the Salvation Army for church purposes. As well, the February-March 1985 data reflect the presence of workers under the Voluntary Initiatives Program.

project to structure demand to make use of the Orion more efficient. However, in the absence of constant and rigorous internal analysis of vehicle/dispatching efficiency, there was uncertainty about how well STS was performing in this area. The Orion also reduced the service's flexibility in that it inhibited experimentation with alternative vehicle mixes vis-à-vis the kinds of services the project initially intended to provide.

- The reliability of the Orion, and issues of contention between STS and the manufacturer over servicing and mechanical operations, interrupted STS's services and strained staff/volunteer resources.

2. The 1984 Ford Econoline (Handivan) was equipped with a wheelchair lift and had capacity for up to 10 ambulatory, or eight ambulatory and two wheelchair passengers. It was mainly used for medical trips and lower-volume, many-to-many-or-few trips. It also was available for weekend or evening service provided by qualified volunteer drivers (e.g., church services). The vehicle's height limited access to some apartment block entrances, and it had a rather high front step to be negotiated by ambulatory passengers. In general, though, the vehicle was more maneuverable than the Orion and had less downtime.

Volunteers provided passenger trips in their private cars as well as other STS vehicles. Volunteers also provided a variety of other services to the STS project and were considered a vital part of the transportation model being demonstrated. Table 5 profiles the volunteers(other than the Board of Directors).

TABLE 5

Profile of STS Volunteers

Factor	Survey Sample as of May/85	Survey Sample as of December/85
- % of volunteers from the service area (R3L, R3M districts)	55%	55%
- % of volunteers who are retired	48%	48%
- % of volunteers who are registrants	25%	40%
- functions at STS:		(active only)
office assistant	27%	28%
driver	25%	38%
escort	7%	7%
interviewer	7%	3%
combination	32%	24%
non-response	2%	-
- average hours/volunteer/month		
number of respondents	44 (active & inactive)	29 (active only)
hours:		
office assistant	6.5	12.6
driver	4.0	5.7
escort	1.5	3.9
interviewer	5.8	1.7
combination	8.1	9.4
	6.2	6.3

SOURCE:

IUS

MANAGEMENT RECOMMENDATIONS - SPECIAL TRANSPORT SERVICE

The project did provide convenient affordable and caring service to the elderly residents of the target area for two years.

It appeared that little abuse was made of the service. Evaluation showed, however, that, although ridership remained high through to the last day of the project, fewer users were taking advantage of the service, but, those few were using the service more frequently during the latter stages of the project.

Had the initial registration form been updated on a regular basis by means of a phone call, or a follow-up letter to the registrant, more registered users who never or seldom used the service might have been aware of its availability.

Registration of new users throughout the project term was continued on an "on-demand" basis, as eligible residents became aware of the existence of the service.

Marketing of the service was carried out in a limited way throughout the duration of the demonstration by means of regular printing of fact sheets and bulletins. A more proactive approach should have been taken to inform prospective users about the project after the initial stage of the project.

The resultant increase in demand could have prompted greater scheduling flexibility or increases in resources to meet the need.

The staffing pattern suited the purpose of the project well. The use of trained volunteers at all levels of service delivery provided a caring and committed service. Members of committees and Board co-operated to meet the original committee goals. Commitment to the project was high and a spirit of good will and sense of "ownership" prevailed.

The system design was created as the project developed. Attempts were made to provide an efficient routing and pick up and delivery system at the same time as collecting sufficient statistical data to provide a paper trail for evaluators. This was not always achieved. It is recommended that a dispatch system with built-in retrieval mechanism be designed at the outset of any such transportation service. Use of a computer-based system would reduce the margin of error.

It may be that S.T.S., in its desire to meet the needs of the mobility handicapped elderly, attempted to accomplish more than was reasonable in the two-year period. It did, however succeed in raising the issue for communities and funders. On April 1, 1986 Special Transport Service merged with a similar service operated by the Fort Garry branch of the Royal Canadian Legion. The new independent organization, Seniors Transport Service, Incorporated continues to offer transportation services to older persons in south Winnipeg.

The City of Winnipeg and the Province of Manitoba recommended that funds be provided for an assessment of these services in terms of the implications for developing similar services throughout the City of Winnipeg. This makes an important philosophical statement by government. The trend of an aging population who will require more convenient transportation cannot be reversed. The time to design systems to meet the needs of that advancing population is now.

DIAL-A-RIDE FOR PEOPLE WITH DISABILITIES IN LONDON

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THE NEED FOR DIAL-A-RIDE

There are, according to recent surveys, around 400,000 people with disabilities in London, constituting 6% of the city's population of 6.6 million. Of these, the majority (300,000) are elderly, (Source: GLAD 1984), with about 20,000 - 30,000 people requiring the use of a wheelchair (Source: NAU research). The extent to which such people with disabilities can use public transport is a product not only of personal physical mobility but also of a variety of other circumstances such as the design of buses and trains, distance to bus stops and stations, the layout of stations and bus stops (particularly weather protection, seats etc.), level of assistance available to individuals etc.

For example, in the 1986 FoLDaR On Bus Survey of Dial-a-Ride Users, 41% mentioned difficulties in getting on and off buses as the main reason why they could not use conventional public transport. Another 43%, although they had difficulties in getting on and off buses, had additional reasons for being unable to use conventional public transport, mainly problems with *getting to* bus stops or stations, which alone was quoted by a further 10% as their sole reason for not using buses and trains. The other 6% had further specific reasons.

Overall, the Greater London Association for Disabled People (GLAD) consider that the number of those disabled in respect of their use of public transport is at least 5% of the general population and probably more, numbering between 300,000 and 400,000 people in London. A survey of one in four households in the central London Borough of Camden has found that one household in eleven (9.1%) reported at least one member with a long term health problem or disability who "has difficulty using public transport without help" (see Public Attitudes Surveys, 1986).

These figures represent a similar proportion to that found in other studies conducted in Manchester, Liverpool, Stockholm, Canada and the USA (see ECMT (1986), Rihani (1982), Spastics Society (1979) and Grey Advertising (1978))

CONVENTIONAL AND SPECIALISED TRANSPORT PROVISION

Improvements to the design of conventional buses and trains can yield significant improvements, but usually take a long time to implement. For example, it was only in 1983 that London Transport (now London Regional Transport [or LRT]) commissioned a study on bus design with respect to passengers who have physical difficulties in boarding (the elderly, women with shopping and/or young children and people with disabilities). It was discovered that 26% of people were simply unable to board buses due to step height and design. Relatively simple and cheap design modifications have reduced this to 5%, but it will be many years before all the existing bus stock is replaced (see Potter 1985). Similar improvements are underway in the design of new rolling stock for urban railways. The first totally accessible metro was San Francisco's BART, followed by the Metros of Washington, Stockholm, Tyne and Wear in Britain and the Lille Metro in France (see ECMT, 1986, pp 129 & 131). London's new Docklands Light Railway, the first stage of which is due to open in 1987, was designed taking the needs of passengers with disabilities into account. This includes lifts to platforms at all 16 stations, level access on to trains and the special design of stairs, handrails and information signs.

Such measures as these, coupled with better facilities for people with disabilities at bus stops and stations, will certainly help make public transport more accessible. However, there are limits to this process for, as FoLDaR's own surveys show, the majority of people who currently use Dial-a-Ride would not benefit by improved bus or train design because they are unable to reach bus stops or railway/metro stations. Of the 30% who gave difficulties in getting on and off buses alone as the main reason for not using them, (i.e. they did not have problems getting to bus stops), two thirds were wheelchair users, who are not catered for in the improved design of general buses. Such improvements, although designed to help a wide number of people, not just those with disabilities, will only help the more mobile disabled person. On the basis of LRT and FoLDaR studies, improvements to vehicle design alone will only reduce the number of people in London who are unable to use public transport from within the 300,000 to 400,000 range at present to 266,000 to 355,000.

To have a more significant impact, vehicle design modifications need to be combined with other measures, such as shorter distances between stops, bus route modifications and improved footway designs, which aid access to bus routes. On the basis of the FoLDaR survey, this would aid a further 10% of people with disabilities, reducing the number unable to use public transport in London to between 200,000 and 300,000.

Design improvements to conventional public transport vehicles and systems can yield major benefits for people with disabilities in return for quite small costs. However, such measures clearly have their limitations. To go further and change bus routes, distances between stops etc., involves a very different decision making process to that of bus and train design. Improvements to vehicle design benefit all passengers, but once the operating system is modified, then a trade-off is inevitably involved between the needs of passengers with and without disabilities. The very nature of, and limits of conventional public transport operations means that a point must be reached where a specialist transport system catering

for people with disabilities is a more effective approach than adapting the existing public transport system.

Of course, many people are able to make their own transport arrangements to some extent or other. This varies from the sole use of a specially adapted car, through to lifts arranged by family or friends. In the 1974 GLAD report, 41% of respondants to their survey used a family or friend's car. However, this does not represent regular access to private transport, which is only available to a small minority of people with disabilities. In Britain as a whole, there are only 50,000 cars adapted for use by drivers with disabilities, about 2% of the estimated total of people with a mobility handicap. Without an accessible form of public transport, most people with disabilities depend on the occasional trip out with friends or relatives, plus, perhaps, some Social Services transport. Generally life can become very isolated.

In Sweden, which has a particularly long experience in the field of specialist transport for people with disabilities, a long term level of about 4% of the population is estimated to require the use of specialist transport. Applied to London, this proportion suggests a figure of 264,000. This is almost in the middle of the range suggested by the GLAD/FoLDaR figures.

SPECIALISED PUBLIC TRANSPORT PROVISION IN LONDON

There is clearly a large segment of the population whose travel needs cannot adequately be met by conventional public transport. During the last seven years, London has seen three major initiatives in catering for the transport requirements of mobility handicapped people. These are:

A) THE MOBILITY BUS: Conventionally-sized adapted buses operating on fixed routes for people with disabilities.

B) TAXICARD: The subsidising of ordinary radio-controlled taxi cab services for people with disabilities.

C) DIAL-A-RIDE: Door-to-Door service using adapted mini-buses booked by telephone.

The Mobility Bus

This is a direct attempt to provide a specialist service for people with disabilities while retaining the operational characteristics of conventional public transport operations. The concept of the Mobility Bus was an initiative of the Greater London Council, the strategic transport authority for London, but was implemented after responsibility for public transport provision was removed from them to central Government. The Mobility Bus is an adapted single decker bus which has the facility to carry ambulant as well as wheelchair-using passengers and has a lift for boarding and alighting in addition to a standard step entrance. It operates on fixed routes, on which the bus will stop at any point. The first service was introduced in November 1984. Currently one bus operates on routes in North London and a second in East London. The services are once a day, one day a week only to popular shopping destinations. A similar approach is

Alder Valley's *Careline*, linking the main London railway stations to Heathrow Airport. This is due to begin operations later this month.

This approach overcomes some of the problems and conflicts involved in adapting conventional buses to serve mobility handicapped people, but the impact of such services is limited. The basic operation is suitable only for high flows to popular destinations at infrequent intervals. It therefore can only offer a very partial solution to the public transport requirements of people with disabilities.

Taxicard

In 1982 the Greater London Council agreed to fund an experimental programme of transport initiatives aimed at providing a basis for deciding the most effective way of meeting the public transport needs of people with disabilities (see GLC, 1985). This programme, which also included the funding of local Dial-a-Rides, saw the birth of the "Taxicard" scheme, whereby people with transport disabilities (either receiving a Mobility Allowance [a state benefit for people who are unable to walk] or who produce certification from a doctor saying they are unable to use public transport because of a disability) could obtain up to a £6 taxi journey for £1.

A pilot scheme was launched at the beginning of 1983 in one London Borough, extended after 6 months to four additional Boroughs. In late 1983 it was decided to organise Taxicard on a permanent basis for the whole of London. This took effect in mid 1984, with 4,500 radio taxis out of London's 13,500 licensed taxis being available to Taxicard members. By early 1986, Taxicard had 55,000 members and an annual budget of £5.2m ($Can 10.8m). With an average of 1.2 trips per member per month, the subsidy of taxicard averages £5.50 ($11.44) per trip.

Upon the abolition of the Greater London Council, in April 1986, the responsibility for Taxicard passed to individual London Boroughs. All but two decided to continue the scheme (and these two are currently reconsidering their position), which is being administered by London Regional Transport.

There are clear advantages in using existing taxi services to provide transport for people with disabilities. The whole operating system is geared to door-to-door service and by 'adding on' to a large existing transport operation, economies of scale can be achieved. However, Taxicard has not been without its problems.

In terms of vehicle design, London taxis are far from ideal. They cannot take people in wheelchairs and have a high door step, making boarding and alighting difficult for even ambulatory disabled people. As in the case of bus designs, new, more accessible, taxi designs have been proposed, a process in which the Department of Transport and the Transport and Road Research Laboratory have been very active. A new DoT and GLC funded taxi design, the CR6, was conceived, which was entirely wheelchair accessible. However, design problems with the CR6 have resulted in this project being abandoned (see *Community Transport*, 1986). In the short term, an adaptation of the existing London taxi design, the FX4, to take wheelchair users has

rapidly been developed by its manufacturers. London's first FX4W ('W' for wheelchair) was licensed in June 1986. For the longer term, a privately developed wheelchair accessible design, Metro-Cammell's *MetroCab* has entered the market, so it seems that, in the longer term, London's taxi fleet will gradually become better suited for people with disabilities.

Operationally there have been problems unrelated to vehicle design. Taxi operations are most heavily concentrated towards the centre of London where most demand for taxis exists. Demand from Taxicard users is more widespread, and some in suburban London were suffering problems with taxi operators refusing to accept their booking as it would take them out from the more lucrative central area. In early 1985, the GLC introduced additional payments to taxi drivers as an incentive to meet requests they might otherwise view as uneconomic. A second problem relates to the general organisation of radio taxi operations. Bookings are accepted and then allocated to individual taxis close to the time of travel. Although bookings are geared to the general capacity of the taxi firm, occasionally the firm has to cancel a trip. For someone who cannot use conventional public transport such a situation can be disastrous when they are far from home. Although infrequent, this element of unreliability discourages many people from using Taxicard.

Taxicard is certainly a workable door-to-door transport system for people with disabilities, but just like adapting conventional public transport for people with transport handicaps, adapting taxi services has design and operational limitations. These limitations are less than for conventional public transport, but are very real and the modifications necessary to fully overcome them are likely to make Taxicard-type schemes as expensive as specially designed services.

Dial-a-Ride

Dial-a-Ride is a specialist service providing general public transport for people with disabilities. Schemes are arranged on a local basis, with both the vehicle design and the operational system built around the requirements of the users. It is a door-to-door service using specially adapted minibuses, all of which can accommodate wheelchair users. At present, most of London's 31 Dial-a-Rides operate 3 - 5 minibuses.

London's Dial-a-Rides employ professional drivers and office staff. Travel requests are made by telephone to a 'despatcher' who matches these requests to bus capacity and location. Radio contact between the offices and buses was introduced in 1985, which permits despatchers to fit in any last minute requests, notify drivers of cancellations or for any other operational purpose. Only one Dial-a-Ride at present uses a computer for despatching. Given London's complex road and traffic situation, combined with the varying mobility level of users, a computer cannot be used to assign trips and is therefore an aid to manual despatching.

The pattern of demand shows travel to be concentrated strongly between about 10.00am and 5.00pm. According to the March 1986 GLC/FoLDaR statistical returns, 10% of all trips occurred before 10.00am, 24% from 10.00 - 1.00pm, 30% from 1.00 to 4.00pm, 18% from 4.00 to 7.00pm, 14% from 7.00 to 10.00pm and 4% after 10.00pm. Difficulties are experienced in

matching these variations in demand to bus capacity. This largely relates to Dial-a-Ride's small scale of operation, meaning that the flexibility associated with larger operations to use marginal resources at peak times is not present. Another consequence of the small operating scale is that 'semi-scheduled' services, from people's homes to popular destinations, are relatively undeveloped. Average occupancy is 1.3 bookings per vehicle trip (although couples often travel on one booking, so the number of people per vehicle trip will be slightly higher than this). Semi-scheduled services average around 5 - 6 people per vehicle trip.

The Origin and Growth of Dial-a-Ride

Dial-a-Ride in London has a distinctly different origin than other provisions for people with transport disabilities. This is that the initiative and control of its development has come from the community of people with disabilities themselves. The first schemes were proposed by Borough disability groups in the late 1970s, with the first, Islington, starting operations in 1980. By 1982, five Dial-a-Rides (Brent, Hammersmith & Fulham, Islington, Ealing and Camden) were operational, having attracted a mixture of funding sources.

Other Borough disability associations, the Dial-a-Rides and their Federation, FoLDaR, won the backing of the GLC for funding to establish 29 local Dial-a-Rides covering the whole of Greater London, an area of some 157,000 ha. This London-wide coverage was achieved by June 1985 and currently 36,000 people belong to the London Dial-a-Rides. In the financial year 1985-86, GLC grants of £3.6m ($7.6m) were made to the London Dial-a-Rides, which by the end of this period were carrying 30,000 people per month. Average cost per trip subsidy is around £10 ($20), although this figure is somewhat deceptive owing to the fact that many Dial-a-Rides were still in their first months of operation. Recently, a number of established Dial-a-Rides have achieved a cost per trip figure of £7 ($14.40) or less.

There also exist two specialist Dial-a-Rides for the Asian community. Given the dependance of Dial-a-Ride on the telephone, language problems restrict some ethnic groups from using Dial-a-Ride services. This, together with other cultural distinctions, provide a basis for such ethnic Dial-a-Rides.

THE PUBLIC TRANSPORT MIX

All the above ways that provide a public transport service for people with disabilities have their own weaknesses and strengths. Each is suited to some people and trip purposes better than others. Some integrate people with disabilities in with conventional public transport, which when possible makes social and economic sense. Others recognise the distinct needs of people with disabilities, which requires a specialist service.

The overall picture that is emerging in London is that this variety and mix is vital in order to adequately cater for the public transport needs of all people with disabilities. Overall, what now is crucial is a comprehensive approach to providing this transport mix, so that each travel mode is being used for the journeys and people most suited to it. For example, it is more effective to use Mobility Bus-type services for large flows to popular destinations than Dial-a-Ride which is better suited to general, more dispersed, trips. Just as conventional public transport has developed a hierarchy of local, medium and long distance services, which both serve users better and utilise resources more effectively, so public transport for people with disabilities requires to sort out its own hierarchy. It is still early days in London and quite how this is to be done is yet to be established.

POLITICS AND ORGANISATION

The actual organisational and political circumstances in which London has established its Dial-a-Ride services deserve particular consideration. The early Dial-a-Rides were very much isolated from each other. Although they were conceived with the goal of achieving a London-wide public transport service for people with disabilities, the practical reality was that only localised schemes were possible. The local Boroughs were in the business of catering for people with disabilities. They ran special centres and provided transport to them. London Transport had no such tradition, so it was largely in and around Borough social services committees where people with disabilities and others saw the need for individual public transport beyond the usual large coaches undertaking long trips ferrying people who could not use public transport to day centres and other institutionalised centres of provision.

1981, the International Year of Disabled People, gave Dial-a-Ride development a boost and a number of local boroughs within London saw the beginning of local schemes in the formation of a Dial-a-Ride sub-committee of some local organisation of (or for) people with disabilities. As noted above, by the following year, five local Dial-a-Rides were operational in London. In 1982 came the GLC initiative, when they committed some £500,000 (Can$ 1.03m) to a programme of "experimental innovations in public transport for people with disabilities". The GLC was, at this time, the London-wide elected authority responsible for transport planning and controlling London Transport's policies and operations. Over the next four years the GLC were to come into direct conflict with the Government over this role, resulting in the removal of London Transport from GLC control, later followed by the abolition of the GLC itself.

The Labour Party administration of the GLC had, in 1982, a highly populist approach, one which was novel to Britain at that time, building a constituency for disparate groups previously ignored: women, blacks, gays, people with disabilities. Rapidly, funding of the early Borough Dial-a-Ride schemes shifted to the GLC's experimental budget. Many people with disabilities greeted this development enthusiastically. It meant that Dial-a-Ride was now funded by the same body as the rest of public transport. Also, transport was the GLC's and London Transport's business, whereas for individual London Boroughs, transport was a relatively insignificant sideline. It was not clear that the Boroughs had the power to provide a true public transport service and it was certainly clear that only some were willing to do so. The shift in funding and responsibility to the GLC thus marked a significant advance in Dial-a-Ride's development.

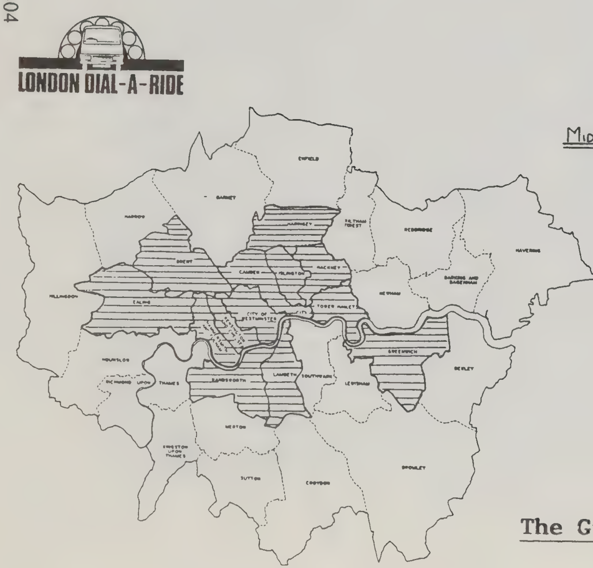
Across London, groups responded to the availability of funds, putting pressure on the GLC to abandon its stance that the funding was for "experiments" and to accept that Dial-a-Ride was here to stay. Groups of people with disabilities, local community transport groups or sub-committees of existing organisations formed themselves to the point where they could submit funding requests to the GLC. There was a rapid growth in Dial-a-Ride schemes, with London-wide coverage being achieved by June 1985.

Progress up to this point had been extraordinarily fast. In 1978, the London Borough of Islington claimed that its Dial-a-Ride, planned to start

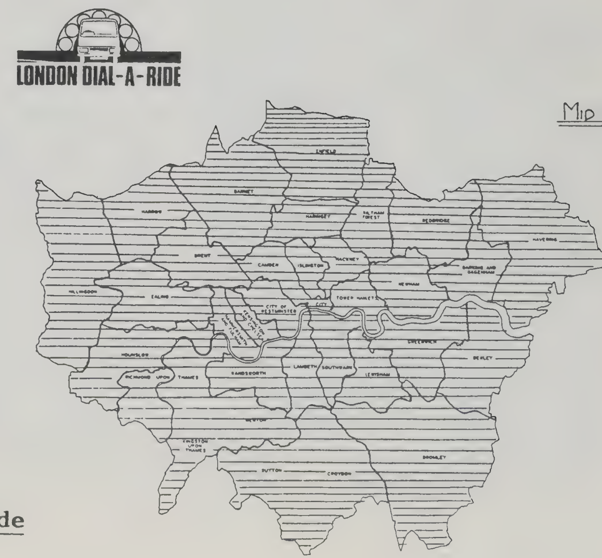
1980

1982

Mid 1984



Mid 1985



The Growth of Dial-a-Ride in London

in 1979, would be the first in London. It actually started in 1980 and within six years there was a Dial-a-Ride scheme covering every London Borough. In this period, the Federation of London Dial-a-Rides (FoLDaR) was formed to help accelerate this process. FoLDaR was started by a small group of individuals who saw the need for coordination and a common front presented by Dial-a-Rides, particularly users and potential users. FoLDaR was funded by the GLC, whose populist approach allowed them, without too much discomfort, to fund organisations who would then be critical of the funding organisation itself. FoLDaR was able to work with the GLC very effectively in promoting Dial-a-Ride across London and in constructing the network on sensible and professional foundations.

Thus the pattern of Dial-a-Ride in London came to be that of local management committees granted funds by the GLC to pay for the Dial-a-Ride service for the population of their particular Borough or, in two cases, a number of Boroughs together. Overall, there are 29 separate and autonomous Dial-a-Rides and two ethnic specific Dial-a-Rides in London.

This organisational structure had definite advantages in the early days. It allowed fast and incremental development when funding agencies had an "experimental" view of Dial-a-Ride and were uncertain of its worth or viability. The scale of initial operations was small enough, at seven or eight staff, to be manageable informally, using the enthusiasm of the management committees and guidance from local agencies and councils. This structure also allowed users to control or participate in a number of crucial decisions. These included what service area to operate within, how long ahead bookings should be accepted, level of fares, if any, and so on. These factors have an important impact on the nature of the service, and in London, Dial-a-Rides have varied from the extremes of previous day only bookings and operating only within the Borough boundaries to unlimited book-ahead times and distance.

Fares

All the Dial-a-Rides decided to charge fares that were as near as possible to the equivalent charged to able-bodied people on conventional public transport. This means that, for short distances, Dial-a-Ride is considerably cheaper to the user than Taxicard, though it is about the same for longer trips. However, the principle of 'bus rate fares' has been subject to varying interpretations. Conventional bus fares have changed from a mileage to a zonal system and some Dial-a-Rides have developed their own scales and zones, so overall, some differences in fares have emerged.

Service Area and Book-ahead Times

The size of area served and the amount of time ahead of a trip that bookings are accepted both have a significant effect on the numbers carried, trip types and type of Dial-a-Ride user. This involves a 'trade off' between these factors, the exact relationships between which are still unclear. In the absence of hard information, most Dial-a-Rides have sought a compromise solution, typically involving a 7 to 14 day book-ahead period and a service area extending about 3 miles beyond the Borough catchment area. Some services now operate 6 - 7 vehicles, having obtained extra resources from sympathetic Boroughs, charities, health authority contracts

etc. At this scale of operation, they can differentiate their services by offering a swift local service with a short book-ahead time in conjunction with longer distance services on a longer book-ahead period. This is intended to meet both the needs of short, day-to-day, journeys together with the numerically few (but often important) long and long term planned journeys (see Potter and Hagyard, 1986). In the longer term, this hierarchy of transport provision could well be developed further, integrating Dial-a-Ride with other transport modes.

User Influence

The position of users on controlling committees had two other aspects. Firstly it meant that staff, especially drivers, were encouraged to have a better attitude to people with disabilities than traditionally was held by Social Services or other institutionalised transport operatives. Secondly, the principle of user control suited the populist orientation of the Labour-controlled Boroughs and the GLC that were the early funders.

Organisational and Political Change

In its 1983 election manifesto, the Conservative Party announced its intention to abolish the GLC along with a number of other Labour-controlled city-wide authorities in Britain. When FoLDaR discussed the impact of the abolition of Dial-a-Rides' funder with the (then) Minister of State for Transport, she told FoLDaR that after abolition the local London Boroughs would - or must - fund the Dial-a-Rides. This would be on an individual local basis rather than part of a comprehensive scheme funded by a London wide rates precept as was the case under the GLC and was intended to continue for conventional public transport under the Government's new provisions. FoLDaR took the view that this was unacceptable. Having got Dial-a-Ride funded as part of overall public transport planning with the GLC, there was no desire to return to the fragmentation of Borough funding. There were real doubts about the willingness of many Boroughs to fund Dial-a-Ride and the government had no real power to force them to do so. If Dial-a-Rides were to return to the Boroughs, any hope of a system integrated within itself and with other public transport modes would be lost.

Following its return to power, the Conservative Government, in 1984, removed from the GLC its strategic public transport role. A new body, London Regional Transport, was set up, not responsible to a body democratically elected by the people of London, but to central government. In the course of the passage of the Act of Parliament setting up London Regional Transport, people with disabilities, led by FoLDaR, lobbied Parliament, having a particularly strong and vociferous meeting with the Secretary of State for Transport. Subsequently, the House of Lords forced an amendment on the Government, requiring London Regional Transport to provide for the needs of people with disabilities. This was the first time any public transport authority had been given this as a legal duty.

In the end, the government accepted that Dial-a-Ride should not be the responsibility of London Boroughs, and on the abolition of the GLC, on March 31st of this year, London Regional Transport became the funding agency responsible for the Dial-a-Rides. Despite achieving this goal, major

difficulties remain and the climate has become decidedly chilly. Firstly, because London Regional Transport has been told by the Government that its funds for Dial-a-Ride are strictly limited to £5m ($10.3) p.a. for the next three years. This stops the growth of Dial-a-Ride and is not even enough to fund the existing 31 services at their current level. Already tight staffing levels have become tighter and various other services, such as mailings to members and accounting services have been cut. FoLDaR itself (six staff) was not funded by London Regional Transport.

The second element in this cooling of the climate is that the pressure is felt to be on the Dial-a-Rides to provide more, shorter trips, to improve cost effectiveness. For some time the government has publicly criticised the cost of London Dial-a-Ride on the basis of crude and misleading 'cost per trip' figures. In Parliament and elsewhere, the Minister of State for Transport compared London Dial-a-Ride costs unfavourably with the cost of Dial-a-Ride operations elsewhere in Britain, especially with a particular scheme recently begun in part of central Birmingham, which was providing a 'high velocity' service of short trips in a small service area.

This simplistic analysis, partly based on incorrect statistics, totally ignored the different operating conditions and scale of service between the two cities (see Potter, 1985b). However, it shows the political expectations of the Government towards London Regional Transport now that it is responsible for Dial-a-Ride. London Regional Transport are felt to be under pressure from the Government to demonstrate their good management of Dial-a-Ride by producing efficiencies - presumably in reductions in cost per trip - to substantiate the Government's public condemnation that the GLC and all associated with it were extravagant and wasteful of public money.

A concentration on the costs of Dial-a-Ride rather than its benefit is partly due to the differences in subsidy per person needed. This is not surprising, given that Dial-a-Ride caters for those most in need and is thus providing that part of the total public transport function which requires the highest subsidy. As Dial-a-Ride is (hopefully) integrated into the whole of public transport, the line between special services and conventional public transport will become blurred, making less sense to castigate one section of a total service for its expense compared to another section, since all serve the same general population. Moreover, although there is evidence that expenditure on Dial-a-Ride reduces the cost of other forms of social and domicillary provision, the compartmentalising of government funding stifles such a cost-benefit approach.

The final consequence of the current situation is that London Regional Transport is perceived as not being over-friendly to the notion of user control, local management committees or FoLDaR. The report accompanying FoLDaR's unsuccessful application for post-GLC funding to the London Boroughs Grants Committee included the statement that:

"LRT does not believe that the Federation will be of any direct help as it could deflect or hinder their (LRT's) direct links with each Dial-a-Ride"

(London Borough Grant Committee, Ref E 110, 27/2/86)

Happily, after the local elections of May 1986 took control of the London Boroughs Grants Committee from the Conservatives, FoLDaR won an appeal against the original decision. FoLDaR's future is again assured.

The Role of a Funding Agency and Local User Involvement

Clearly the last two years have been a disturbing time for Dial-a-Ride in London. The abolition of the GLC has caused problems of uncertainty and reorganisation, but at least Dial-a-Ride has survived and in a viable and practical form.

A current issue for Dial-a-Ride in London is the working out of relations between LRT and management committees. (Any relations between LRT and staff which fall outside this are beyond the scope of this paper). LRT are felt at times to be impatient with local management committees and to wish to work directly with the professional Dial-a-Ride Co-ordinators, relegating management committees to the sidelines. But in reality, LRT is no more capable of managing 31 Dial-a-Rides than the Dial-a-Rides are able to operate without LRT funding. It is important that all concerned recognise our interdependance. Both parties have demands on them - the effective delivery of a transport service to people with disabilities - that largely coincide.

Local management committees need the support of a helpful and friendly funding agency. When a committee is suffering from fatigue or a particular problem, a supportive bureaucracy is vital. With the perception that London Regional Transport is against local management committees, they are unlikely to turn to LRT for support.

However, London Regional Transport itself is facing threats, including privatisation, cuts in their own funding, and widespread redundancies among staff. An unequivocably friendly and supportative bureaucracy would not only be preferable to one which itself is suffering in this way but would itself gain strength from a positive relationship with 31 management committees.

The present control by user management committees of day-to-day operations of Dial-a-Ride may not be easily compatible with LRT's traditional management style and structure. But nevertheless the principle and reality of user involvement is not to be cast away lightly. In under 8 years, user-led initiatives have taken public transport for people with disabilities from a dream to the reality of a unit within London Regional Transport funding 30 schemes with over 100 buses. However, the concomitant of this is that London Dial-a-Ride is now increasingly part of a far larger bureaucracy, which will wish to impose its own conditions in management terms as well as taking an overall view of the operations of Dial-a-Ride. It may be sensible at this point to consider whether the day to day line management may be better carried out by the larger bureaucracy, with local user management committees and FoLDaR shifting emphasis towards service monitoring and strategic policy issues.

It is crucial that the Dial-a-Rides do not focus too much attention on London Regional Transport's attempts to influence the use of the very limited funds that are now available for operating these services. Clearly,

where bureaucracy threatens to do violence to our right to self-determination, it is to be resisted. But it is the commitment of the Government, who have replaced the GLC's expansionist programme with real and increasing cuts, which is the real source of concern, and upon whom our attention should now be focussed.

THE FUTURE

People with disabilities have for generations been forced to accept a low-mobility existence. For some, Dial-a-Ride has been an incredibly liberating force. Yet Dial-a-Ride, together with other transport initiatives for people with disabilities, reach only a small proportion of those in need. The current total membership of Dial-a-Ride is 36,000, with Taxicard having 55,000 members. A 1984 GLC survey indicated that around half of Taxicard members also belonged to Dial-a-Ride, so the overall membership of both schemes is probably around 70,000. This means that the present schemes are only reaching a quarter of the estimated total of 264,000 people in London who require specialised transport. Added to this is the fact that the 'active' membership of these schemes is considerably less than the total, for Dial-a-Ride and Taxicard do not have the resources to even meet the travel needs of their existing members and many have been put off because of this.

Given a roughly 50:50 split between Taxicard and Dial-a-Ride, a long term Dial-a-Ride membership of 132,000 is to be expected. Currently, Dial-a-Ride users average one trip per month, so at this rate 132,000 trips per month would be generated. A well utilised Dial-a-Ride bus can, in London's conditions, undertake 450 trips per month, so this suggests that, <u>at a minimum</u>, a fleet of 300 Dial-a-Ride buses is necessary.

However, the average trip rate is deceptive, for, among *active* Dial-a-Ride users, the trip rate is about weekly. Were this figure used, then over half a million Dial-a-Ride trips would be made monthly, requiring a fleet of 1,270 mini buses. At this sort of scale, it is unlikely that Dial-a-Ride would continue to operate as it does now. Trip sharing rates would undoubtably be higher, but, more importantly, the Dial-a-Rides could utilise their resources more effectively by integrating door to door services with semi-scheduled and scheduled services, which are better suited to higher flows and longer distance operations. It is no coincidence that a senior GLC transport planner, Martin Foulkes, was studying the concept of a long distance Dial-a-Ride. This initiative had only reached the planning stage when the GLC was abolished and has, for the moment, been lost. At the moment, Dial-a-Ride in London is operating at just below the threshold where the widespread use of semi-scheduled and feeder services is viable. Such operational thresholds are common in public transport operations, requiring a certain level of use to be reached before substantial operational improvements can be achieved. This certainly seems the case with Dial-a-Ride and in London, but, with resources pegged for the next three years, passing through this threshold to achieve a greater utilisation of resources is going to be very difficult.

Exactly how such a long-term, integrated, hierarchical transport system would operate is still somewhat a matter of conjecture and research, in which FoLDaR intends to take an active part. At this stage, a reasonable

estimate for a 'steady state' situation in London would be for something like 800 Dial-a-Ride mini buses, undertaking local door to door transport duties and semi-scheduled trips, plus feeding to/from long distance services (a mix of about 40 special buses, plus conventional public transport, where suitable).

At the moment, although the largest Dial-a-Ride scheme in Britain, London Dial-a-Ride is only just emerging from its early 'experimental' stages. To move towards being an adequate transport service for people with disabilities requires a strong political commitment to the further expansion and refinement of the service. To achieve mobility for people with disabilities requires a mixture of a number of different forms of provision in order to provide both the best overall service and the most effective use of resources. All the schemes considered in this paper, Dial-a-Ride, Taxicard, Mobility Buses and the improved design of conventional public transport systems have a role to play. Perhaps, above all, what is needed is a positive attitude seeking to integrate and plan these services as a whole. The future must lie along such integrated planning lines.

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CUSTOM TRANSIT SERVICE FOR THE DISABLED IN GREATER VANCOUVER

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CUSTOM TRANSIT SERVICE FOR THE DISABLED
IN GREATER VANCOUVER

INTRODUCTION

BC Transit was established as a provincial Crown corporation by the BC Transit Act of 1978 and assigned responsibility to:

1. designate local and regional transit service areas;

2. establish local and regional transit commissions;

3. consult with local municipalities with a view to providing transit services;

4. establish annual operating budgets and capital budgets for each public passenger system under the BC Transit Act;

5. review all annual operating agreements;

6. provide transit services and maintain and operate a public passenger transportation system consistent with an approved budget in each transit service area;

7. recommend to the Lieutenant Governor in Council the formulas by which a municipality or regional transit commission may exercise its powers to raise funds to contribute its share of transit costs.

There are now conventional transit systems in Vancouver, Victoria, and in 22 other communities. Paratransit systems - usually single-vehicle, demand-responsive services mainly for elderly and handicapped people - operate in ten small communities.

Custom Transit or handyDART, a parallel transit service solely for the disabled, is now available in two regions - Vancouver and Victoria - and in eight other cities.

handyDART POLICY

When it first became involved in special transit services for the disabled, BC Transit looked closely at the types of service that could be provided and evaluated the two main alternatives:

1. Total accessibility through retrofitting conventional buses or replacing existing vehicles with accessible buses which would operate on fixed routes.

2. A parallel service using specially designed or adapted vehicles which would provide a door-to-door service in response to user requirements.

A trial project in Victoria in 1979/80 where conventional buses were modified to board and accommodate wheelchairs experienced low usage and high costs. The conclusion was that a parallel service would be a better answer to the mobility needs of the disabled and elderly. Consequently, the strategy that was adopted by BC Transit then and which is being followed today includes:

1. Defer retrofitting of conventional buses.

2. Support Custom Transit program initiatives.

3. Increase accessibility for the ambulatory on conventional buses.

4. Monitor and seek better equipment and technological developments.

ELIGIBILITY FOR handyDART

A provincial Order-in-Council defines who is eligible to use handyDART. Included are:

a) handicapped persons as defined under the Guaranteed Available Income for Need Regulations;

b) recipients under the Blind Persons Allowances Act;

c) persons who have a disability, either permanent or temporary, confirmed by a medical practitioner, that is sufficiently severe that the person is physically unable without assistance to use a public passenger transportation service.

Note that seniors are not automatically eligible because of age; there must also be a mobility problem which prevents the individual from using regular buses. No distinction is made between residents of British Columbia and visitors to the province.

FUNDING OF TRANSIT SERVICES

All transit systems in B.C. are partially funded by users through fares and by provincial and municipal subsidies. Although the agreed-upon cost-sharing percentages may vary from year to year, the current formula in the Vancouver region targets fares to recover 35 percent of total transit operating costs. Any shortfall in fare revenue is the municipality's responsibility. The other 65 percent of the total cost - the "shareable deficit" - is funded by the province (60 percent) and the municipality (40 percent).

This arrangement is equitable for regular transit where the average total cost per trip is about $2.50. In the case of custom transit where each person trip now costs an average of nearly $12, the same formula

would require a user fare of more than $4.00. To avoid such an unrealistic fare level, a special Provincial Revenue Supplement, equivalent to 25 percent of total operating costs, is made available and is considered part of the 35 percent fare target. Thus, handyDART user fares are expected to recover at least 10 percent of annual costs. The fare for most trips is now $1.25 which in 1985/86 raised 10.5 percent of the total cost of service in the Vancouver Region.

THE VANCOUVER REGIONAL TRANSIT COMMISSION

The Vancouver Regional Transit Commission is comprised of seven locally elected municipal representatives who are appointed to the Commission for a two-year term by the Lieutenant Governor in Council. The BC Transit Act specifies the Commission's duties as:

(a) prepare plans and, consistent with operating and capital budgets set by BC Transit, set fares and determine service and performance standards for each transit system in the regional transit service area in consultation with municipal officials, transit operators, and the public.
(b) review and make recommendations to BC Transit respecting the budget of the commission and the annual operating and capital budgets for each public passenger transportation system in the regional transit service area, and
(c) exercise its powers and perform its duties under sections 11.1, 12 and 14 of the BC Transit Act.

These sections of the Act authorize the Commission to raise its share of the "shareable deficit" through property taxes, power levies, or a municipally imposed gasoline tax, or a combination of these sources.

THE VANCOUVER REGIONAL handyDART SYSTEM

The Vancouver regional transit area includes 15 municipalities, an area of 2,600 square kilometres (or 1,000 square miles), 1.2 million people, and about 11,600 known handyDART users. About 30 percent of these users are in wheelchairs; the others are ambulatory.

The Vancouver region is sub-divided into six service zones as illustrated by Figure 1. There are now seven operating organizations providing handyDART service in these zones under annual operating agreements with BC Transit. Each agreement specifies the number of vehicles to be used, the number of hours of service to be provided daily and monthly, the dollar amounts to be paid for various components of the service, and the total annual budget allocated for the specified level of service. A typical 1986/87 operating agreement budget is reproduced as Figure 2.

Figure 1

Service Zones and handyDART Operators

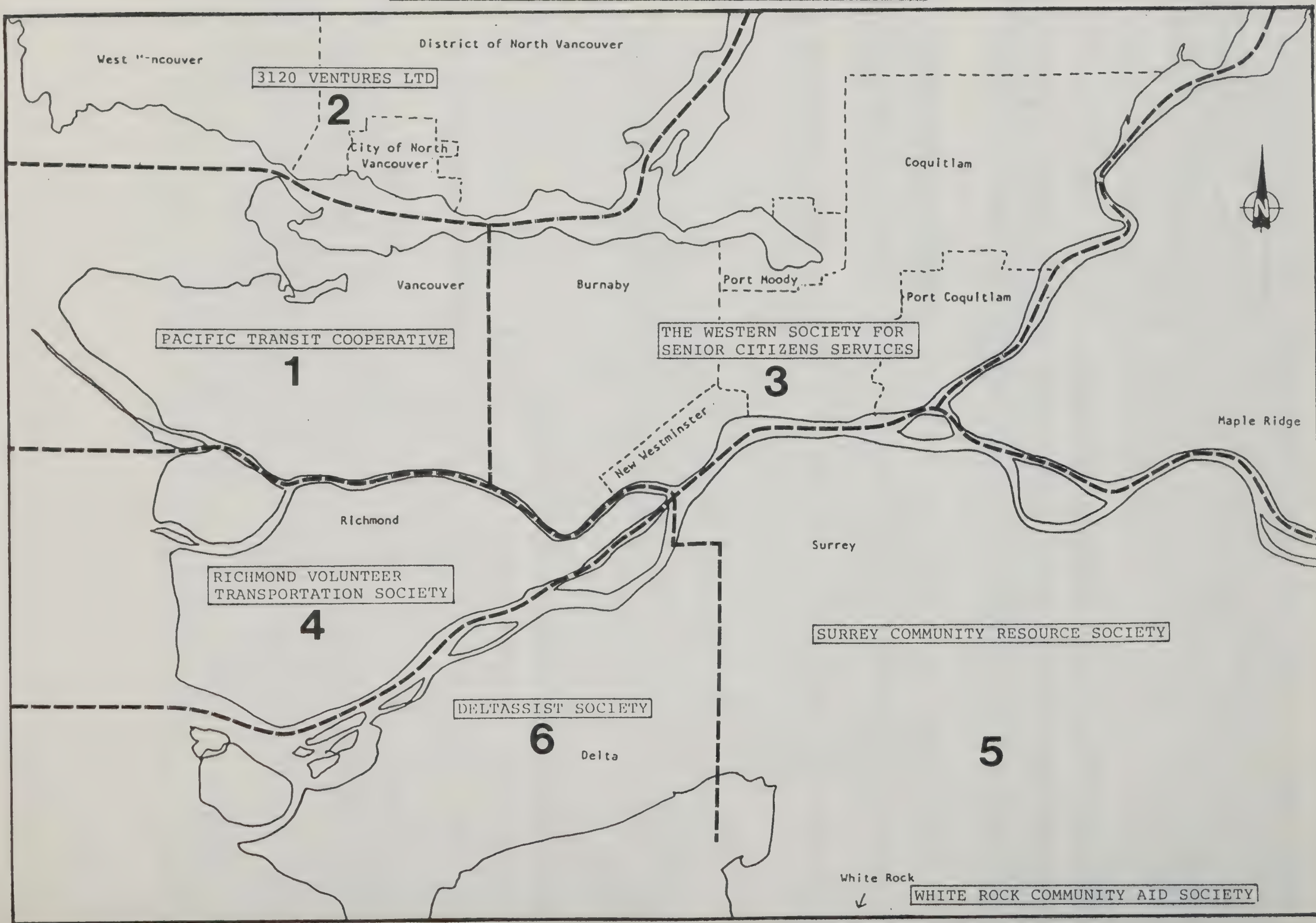

FIGURE 2

Custom Transit Agreement	1986/87

SCHEDULE "C"
Budget
April 1, 1986 - March 31, 1987

Revenue - Farebox and Prov. Rev. Supplement	$179,189
Expenditure:	
Direct Costs of Operation	
Fixed Costs	$99,288
Vehicle Costs per Hour	247,464
Vehicle Costs per Kilometre	48,600
Maintenance Costs	13,656
BCT Insurance	3,120
Contingency	
Fuel	2,340
Service, Other	31,968
Total Direct Costs of Operation	$446,436
Lease Fee	$45,444
Interest Expense	3,876
BC Transit Administration	13,392
Transit Merchandising	2,820
Material and Equipment Expansion	--
Total Expenditure	$511,968
Shareable Deficit	$332,779
Deficit Sharing - Regular Share	133,112
- Revenue Overage	--
Total Local Share	133,112
BC Transit Share	199,667
Total Deficit	332,779

This budget is for an operating agency which has seven vehicles in operation and is authorized to provide 18,290 annual hours of service during 1986/87. Contingency funds in the budget are adequate to operate one additional vehicle and provide up to 1,320 hours of supplementary service, if demand warrants, during the 165-day Expo period.

Six of the seven operating organizations are non-profit societies while the seventh is a private sector firm which receives a small management fee. Each operating agency is reimbursed for all its operating costs so long as it operates within its agreed-upon budget. B.C. Transit makes monthly payments to each agency based on submitted invoices which detail all direct operating costs.

handyDART VEHICLES

The regional handyDART fleet now comprises 96 vehicles in regular service plus another 5 which are in temporary use during Expo. Vehicles are allocated to each service zone or operator by BC Transit in relation to the geographic distribution of handyDART users and the level of service to be provided. For example, the City of Vancouver (service zone 1) contains 53 percent of all users in the region and is allocated 53 of 101 vehicles.

The handyDART fleet contains three types of vehicles:

1. Most important are the 67 lift-equipped vans which have been specially modified to transport the 30 percent of users who are in wheelchairs. Most can accommodate four forward-facing passengers in wheelchairs plus four ambulatory passengers sitting on regular van seats.

2. The fleet also includes 20 vans without lifts to serve passengers with less severe mobility problems. These accommodate seven to ten seated passengers.

3. For those handyDART passengers who have difficulty entering or leaving a van, fourteen station wagons and sedans are available as well.

Because of the rapid expansion of provincial custom transit systems and the need to retain some flexibility in the fleet, BC Transit does not yet own all the handyDART vehicles. BC Transit owns 81 of the 101-vehicle fleet in the Vancouver region. The other 20 vehicles - 14 station wagons and sedans and 6 of the vans without lifts - are leased from a commercial leasing company.

TRIP PRIORITIES

Two trip priority categories have been established for regular handyDART service. First priority is given to trips to or from work, post-secondary education, and medical appointments. All other trips including social-recreational, shopping, personal business, etc. fall into the second priority category.

This system has been modified slightly this year through the provision of extra service (i.e. 5 vehicles and up to 10,000 hours of vehicle time) so that eligible users, whether residents or tourists, who wish to visit Expo can use the handyDART system to do so. Demand for this service during May and June was less than anticipated.

ANNUAL handyDART STATISTICS

Comparative statistics for the Vancouver regional handyDART system between 1980/81 and 1985/86 are summarized in Table 1. The annual regional budget in 1985/86 was $4,887,415 and the actual expenditure was slightly less at $4,734,278. This sum provided 179,740 hours of handyDART service and 399,776 user trips. Productivity increased steadily from 1.54 user trips per hour in 1980/81 to 2.22 user trips per hour in 1984/85, but no further increase was recorded between 1984/85 and 1985/86.

In 1985/86 the total actual cost of $4,734,278 was funded using different cost-sharing percentages than those applicable in 1986/87. Fares recovered 10.5 percent of the cost and the municipal subsidy amounted to 17.6 percent of the total. The province contributed a total of 71.9 percent of the cost - 35.6 percent through the Provincial Revenue Supplement and 36.3 percent as its share of the shareable deficit.

THE 1986/87 SERVICE PLAN AND BUDGET

The 1986/87 handyDART budget and service parameters are summarized in Table 2 and compared with 1985/86 figures. The 1986/87 budget of $5,566,992 is about $833,000 or 17.6 percent greater than the actual cost in 1985/86. This increase includes $470,000 for an additional 17,300 hours of regular service, $233,000 for supplementary Expo service, and $130,000 to account for operating cost increases between 1985/86 and 1986/87. Productivity is expected to increase to 2.3 trips per hour resulting in an annual forecast of 454,000 user trips without the inclusion of Expo-related trips.

CUSTOM TRANSIT USER ADVISORY COMMITTEE

So that the Vancouver Regional Transit Commission and BC Transit can be kept informed of handyDART users' concerns and needs, a Custom Transit Advisory Committee has been established. With the exception of the Chairman who is a member of the Vancouver Regional Transit Commission, all ten Committee members are handyDART users. They sit on the Committee either as representatives of concerned organizations such as the B.C. Coalition of the Disabled or as service zone representatives. The Advisory Committee meets approximately once a month to review Custom Transit service and to bring specific problems to the attention of BC Transit.

Table 1

VANCOUVER REGIONAL handyDART SYSTEM
COMPARATIVE ANNUAL STATISTICS

	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86
Annual Budget	$1,040,000	$3,230,490	$3,974,235	$4,280,209	$4,450,425	$4,887,415
Actual Expenses	967,070	3,028,673	3,764,091	4,114,078	4,327,960	4,734,278
Annual Hours of Service	80,000	168,381	169,071	171,629	172,056	179,740
Cost per Hour	$12.09	$17.99	$22.26	$23.97	$25.15	$26.34
User Trips	123,500	287,300	341,400	373,111	382,435	399,776
Total Passenger Trips *	130,000	303,065	361,926	396,500	406,804	414,965
Cost per User Trip	$ 7.83	$10.54	$11.03	$11.03	$11.32	$11.84
User Trips per Hour	1.54	1.71	2.02	2.17	2.22	2.22
Total Passenger Trips per Hour	1.63	1.80	2.14	2.31	2.36	2.31
Vehicles	36	76	80	83	83	89

* Total Passenger Trips include attendants and escorts who travel with handyDART users.

Table 2

VANCOUVER REGIONAL handyDART SYSTEM
1986/87 versus 1985/86

	1986/87 Budget	1985/86 Actual	1985/86 Budget
Budget Summary			
Total Cost	$5,566,922	$4,734,278	$4,887,415
Revenue - User Fares	$ 556,699	$ 496,840	$ 511,223
Provincial Revenue Supplement	$1,391,748	$1,685,403	$1,739,919
Revenue Target	$1,948,447	$2,158,831	$2,228,661
Shareable Deficit	$3,618,545	$2,575,447	$2,658,754
BC Transit Share	$2,171,127	$1,717,823	$1,773,389
Net Local Share	$1,447,418	$ 834,212	$ 862,884
Performance Summary			
Level of Service			
- Revenue Hours	197,060*	179,740	182,418
- Registered Users	11,600	11,000	11,000
- Number of Vehicles	96*	89	89
Effectiveness			
- Revenue Passengers per Annum	454,000*	399,776	402,000
- Revenue Passengers per Hour	2.3	2.22	2.20
- Cost per Revenue Passenger	$12.26	$11.84	$12.16
- Cost Recovery (%)	10.0	10.50	10.46

* Excludes additional Expo service, vehicles, and passengers.

COMPUTER ASSISTANCE FOR handyDART

Until recently, all booking, scheduling, and dispatching of handyDART service in the Vancouver Region was done manually. In 1986, a demonstration project, jointly sponsored by Transport Canada and BC Transit, was initiated locally to test, compare, and evaluate two software packages which may enable handyDART operators to improve productivity and efficiency. This demonstration project is described in more detail in another paper to be presented at this conference.

CONCLUSION

The Custom Transit program in the Vancouver region, a joint responsibility of BC Transit, the Vancouver Regional Transit Commission, and the local handyDART operating organizations, has evolved over the last six years to provide an improved level of mobility for disabled people in the region. Continuity of funding by both levels of government has ensured a consistent and gradually increasing level of service from one year to the next while service costs have been maintained at levels that are affordable to both handyDART users and taxpayers.

A CHALLENGE FOR THE FUTURE: THE PROVISION OF TRANSPORTATION FOR CALGARY'S ELDERLY AND DISABLED

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INTRODUCTION

Independence is correlated with self-initiative and the determination to strive for a better life. In our society, independence is closely linked to mobility - the ability to physically reach your destination. It is therefore not surprising that for many disabled and elderly individuals, the availability of special needs transportation is of vital importance and its absence a major barrier to independence.

Projections for the future indicate the demand for special transportation services in North America will increase dramatically. The basis for this projection is threefold: an aging population, advancing medical technology, deinstitutionalization and reduced infant mortality among handicapped newborns. The question then becomes, how are we as transportation providers going to be able to meet future transportation demands? It would be naive, not to acknowledge that the funding necessary for the provision of special transportation services is closely linked to legal and political goals. Can we assume that these goals will remain constant or should we heed the warnings being given by governments in their current emphasis of down-scaling existing social programs?

Calgary is situated at the eastern foot of the Canadian Rockies, in Alberta. The city has a population of more than 635,000 people, and encompasses an area of approximately 210 sq. miles. Calgary is characterized by centralized public services and low residential densities. It is the headquarters of the oil industry in Canada. The large geographic area combined with a historical and pervasive sense of independence contributes to a high proportion of private automobile ownership.

Using the City of Calgary as an example, this paper will discuss the provision of special need transportation services now and in the future.

PROGRAM FUNDING

Funding for Calgary's special needs transportation programs comes from two main sources. Part of the funding is transferred from the Federal Government to the Province, which then redistributes the funds to the municipalities via an annual $3.00 per capita grant. These unconditional grants are paid in lieu of public transit operating assistance and are used to contribute to the operation of senior citizen and disabled transportation programs. The remainder of the program operating budget comes directly from the municipal property tax base.

In 1985 the total special needs transportation budget for the City of Calgary was $10,224,809. The funding was split approximately as follows:

Province $1,875,000.
City of Calgary $8,347,809.

DELIVERY SYSTEMS

Currently there are 43,000 individuals (approximately 7%) over the age of 65 in Calgary. Agencies that service Calgary's disabled estimate that there could be as many as 35,000 to 45,000 disabled people in the city. Exact figures on the numbers of disabled needing transportation are difficult to obtain since many disabled individuals utilize the service of more than one agency and many of the disabled would be seniors. Some of the disabled are in institutions located in the city. Approximately 3,500 of Calgary's disabled are confined to wheelchairs.

Providing transportation for Calgary's special needs population is not always easy. Calgary experiences an extreme range of weather conditions with winter temperatures sometimes plunging from -20C to -35C. Snow and ice cover the ground for up to five months of the year with the occasional snow storm occuring as late as May and as early as the beginning of September.

Because of the range of weather conditions, the form and level of transportation services required during the winter months is often quite different that what is acceptable and adequate during the summer. Thus, the type and form of services that would be appropriate for a city with mild winters might not be cost efficient or effective in Calgary.

In response to local conditions, three levels of special needs transportation services have been developed to serve Calgary's disabled and elderly population:

- Handi-Bus,
- Special Needs Taxi, and the
- Senior Citizens Bus Pass Program,

Handi-Bus

The Handi-Bus service is a parallel transportation service primarily for wheelchair users administered and operated by a non-profit organization,

the Calgary Handi-Bus Association. The Association is run by a volunteer board of directors who set the organization's administrative procedures. The program funding is provided by the City of Calgary, through a yearly budget overseen by its Social Services Department. The approved 1985 operating budget for the organization totalled $4,974,309. The cost of running the service is high, averaging over $12.00 for each one way trip the user takes.

No funding is provided to the organization for capital costs. The modified vans, with wheel-chair lifts, used by the organization are obtained through donations from private individuals, corporations and service clubs.

The Handi-Bus program originally developed from a volunteer program initiated in 1971. Today the Association provides service for 3895 registered users and operates 93 vans and 5 cars. Handi-Bus currently has a paid staff of 186 including drivers, booking clerks, dispatchers, mechanics, clerical staff and management.

Handi-Bus offers a demand and/or subscription door-to-door service seven days a week between the hours of 6:30 A.M. and 1:00 A.M.. The cost to the user for each one-way trip is $1.00. Users purchase tickets for the service in advance. The demand service is delivered on a one hour response time, while subscription service may be used for regularly scheduled medical, educational or work related trips.

Any non-ambulatory disabled individual may access both the demand and subscription service, the only limitation being the availability of vans. The ambulatory disabled may use the Handi-Bus service for their regularly scheduled trips but must use the Special Needs Taxi service for any other type of trip.

The Handi-Bus service is currently operating at near capacity. During one recent week 100 requests for vans had to be refused because of full bookings. Another 500 requests for service could not be filled exactly at the time needed, but transportation was provided at a time when vans were available through user re-scheduling.

Special Needs Taxi

The Special Needs Taxi Program utilizes the concept of user-side subsidies and allows the ambulatory disabled 24 hour a day access to transportation. To qualify for the program, the applicant must have a limited income and have a physician verify inability to use the Calgary Transit System safely because of mental or physical disabilities.

Once enrolled in the program a monthly susidy limit for travel is assigned to the user. The monthly limit can be extended if extra trips are needed for reasons of work, education, medical or compassion. Current recommended monthly subsidy levels for single individuals range from $36.00 to $60.00 while married couples may receive a combined subsidy between $54.00 and $90.00, depending upon income. Each program user is issued an embossed plastic card similar to a credit card. The City Social Services Department owns the card embosser and can issue new cards on the spot to new applicants or if a card is lost. Embossed on the card is the users name, registration number and a subsidy limit. When transportation is required the user calls a taxi company of his/her choice from among the 10 Calgary taxi companies participating in the program.

When the trip is complete the user presents his/her card to the taxi driver. The driver imprints the card on a standard charge slip with the same machine used for credit cards. The amount of the fare is based upon the following example:

TAXI FARE	$5.00	
- 10%	-.50	(discount given by Taxi company)
	$4.50	
-$1.50	$1.50	(amount paid by user for each trip)
	$3.00	(amount subsidized by City)

Shared or group rides are encouraged under the program and would be calculated as follows:

TAXI FARE	$5.00	
- 10%	-.50	
	$4.50	
- $1.50 x 2 users	-$3.00	
	$1.50	(amount subsidized by City)

Shared rides allow individuals to pool their transportation subsidies and obtain more trips on their monthly subsidy limit. This feature of the program is especially useful to seniors living in senior citizen housing and nursing homes.

The program currently has 6,600 individuals registered in it and had a 1985 operating budget of $1,250,000. The cost to the city for each one way trip taken under the program is over $5.00. The people registered in the program under the age of 65 take more trips per month than the over 65's, with the average number of trips per month being higher during the winter months than during the summer months.

Senior Citizens Bus Pass Program

The Senior Citizens Bus Pass Program provides transportation for Calgary's seniors on the City operated transit system. Seniors must provide proof of age when registering for the program. The cost is $10.00 for first time applicants and $5.00 a year thereafter. It is one of the least expensive senior citizen transit programs in the country.

All registration for the program is done through the mail. Once a senior registers, a computer generated embossed plastic card is issued with his/her name and user i.d. number on it. The card entitles the senior to unlimited use of the City transit system at no additional cost.

At the beginning of each new year current users on file are sent computer generated renewal forms. This process is necessary to keep file information current and to ensure program accountability.

The user returns the renewal form by mail with the $5.00 fee. If no information has changed the renewal date is changed on the file and once again the computer issues a new card. At the end of the renewal period all user files that have not had a new renewal date entered are eliminated from the data bank.

The Senior Citizens Bus Pass Program had a $4,000,000 operating budget for 1985 and currently has 30,000 seniors registered. The Calgary Transit system bills the Social Services Department on a quarterly basis for the cost of providing service for the seniors. Visiting seniors to the city are eligible for service but are advised to register by mail, prior to their visit.

Table 1 compares the relevant features of the three Calgary programs.

TABLE 1

CITY OF CALGARY SPECIAL NEEDS TRANSPORTATION SERVICES

	SPECIAL NEEDS TAXI	HANDI-BUS	SENIOR BUS PASS
Delivery System	Demand	Subscription, Demand, Charter	Scheduled
Eligibility Criteria	Income and Health	Health	Over 65
People Registered	6,600	3,895	30,000
Service Units	10 Companies with 1,999 Cabs	93 Vans 5 Cars	425 Buses 57 LRT Cars
Hours	24 Hours	6:30 AM - 1:00 AM	Transit Schedules
Fares	$1.50 One-Way	$1.00 One-Way	$5.00 Year
Users	One, Multiple, Direct Trip	Multiple, Indirect Trip	Multiple, Direct Trip
Attendants	$1.50	One Free	$1.00
Driver Service	Rings House, Assistance	Passenger should be ready and at pick-up point. Assists Passengers.	Driver assists passengers off and on bus.
1985 Budget	$1,250,500	$4,974,309	$4,000,000

THE DISABLED IN CANADA AND CALGARY

Comprehensive data regarding the distribution of the disabled in Canada is sparse. For purposes of this paper a modified version of Walker and Mc Whinnies (1980) compilation of the distribution of disability in Canada will be used. Walker and Mc Whinnies defined disability as "...the effects of conditions or impairments on an individual's ability to perform normal daily activities."

Table 2 shows Walker and Mc Whinnie's distribution of disabled in Canada. By using the same percentage distribution as used in Table 2, Table 3 shows the estimated distribution of the disabled in Calgary. Many service providers would claim that these estimates are too low and the actual figures should be 50 to 75% higher.

Table 3 estimates the number of people in Calgary who are disabled, according to Walker and Mc Whinnie's definition. The Transportation Research Board (1983) in the United States has defined individuals as functionally disabled if they have problems walking, climbing up and down stairs, standing, maintaining balance, sitting down or getting up, reaching for or holding things, seeing, hearing, speaking, or reasoning. The Urban Mass Transportation Administration (1983) in the United States estimates that 5.5% of the total U.S. population could be classified as functionally disabled. In Calgary, by using these same calculations, 34,925 people or 64% of Calgary's disabled population would be classified as functionally or transportation disabled.

For purposes of further analysis disabled individuals under 15 years old residing in the community in Calgary will be excluded from discussions. These people receive transportation services from several groups. This is a direct result of Provincial policy, whereby transportation for individuals who are attending school is the responsibility of the Department of Education. The Calgary Handi-Bus Association does provide transportation for approximately 150 pre-schoolers at a cost of $500,000 per year. These children and the budget used for their transportation will not be included in the discussion.

With the elimination of the under 15 age group there still remain 48,168 disabled individuals residing in the community in Calgary. Of this group, 30,734 would be classified as functionally disabled or transportation disabled using the Urban Mass Transportation Administration estimates (1983).

Calgary Handi-Bus and the Special Needs Taxi programs currently provides transportation services for 10,345 (34%) of these people. Seniors using the Bus Pass Program are not included since they would not be classified as disabled. The cost for providing transportation service

TABLE 2

DISABLED POPULATION IN CANADA

TOTAL POPULATION 1980
23,714,700

DISABLED POPULATION
2,325,000 (9.8%)

UNDER 15 YEARS
90,000 (12.5%)

Institutions
40,000 (14%)

Community
250,000 (86%)

OVER 65 YEARS
620,000 (26%)

Institutions
170,000 (27%)

Community
450,000 (73%)

15-64 YEARS
1,415,000 (61.5%)

Institutions
65,000 (5%)

Community
1,350,000 (95%)

TABLE 3

DISABLED POPULATION IN CALGARY 1986

TOTAL POPULATION 635,000

DISABLED POPULATION
62,230 (9.8%)

UNDER 15 YEARS
7,779 (12.5%)

Institutions
1089 (14%)

Community
6690 (86%)

OVER 65 YEARS
16,180 (26%)

Institutions
4,369 (27%)

Community
11,811 (73%)

15-64 YEARS
38,271 (61.5%)

Institutions
1,914 (5%)

Community
36,357 (95%)

to 34% of Calgary's functionally disabled population totals $530 per person per year. While some individuals are eliminated from the taxi program because of its income criteria, Handi-Bus users need only meet medical criteria.

The Handi-Bus and Special Needs Taxi Programs could be put in immediate financial jeopardy if more of Calgary's functionally disabled population made use of the transportation services that are currently available.

FACTORS AFFECTING THE FUTURE PROVISION OF SERVICE

Increasing demands for better transportation services for the disabled and elderly have lead to continued growth in the provision of these services. Projections indicate the need and demand for special transportation services will only increase in the future. To understand this process a brief look will be taken at some factors that will lead to this increased demand.

Medical Technology

During the previous decade, medical technology has advanced at a rapid rate. These advancements mean many disabled individuals will experience longer lives. Advancing technology also means that the number of disabled will increase as the lives of victims of automobile, sport and industrial accidents are saved. While medical technology means more injured individuals will be able to resume normal life functions after accidents, it also means that the number of individuals who will be forced to spend their lives in wheelchairs or as functionally disabled will also increase.

Deinstitutionalization

In Alberta, as elsewhere in North America, the government is pursuing the objectives of deinstitutionalization. The fundamental premise behind this movement is the principle of normalization. Normalization ideally entails a full presence in the community and, a chance for an individual to grow and develop through life in circumstances that everyone else would say are reasonable to live by.

The Province of Alberta, over the coming decade, hopes to return to the community as many non-violent and non-medically dependent disabled individuals as possible. Projections indicate that approximately 500 individuals could return to Calgary. Most, will require special transportation services.

The majority of these individuals will live in group homes which will be spread throughout the city. Each group of people returned to the community will put additional demands on Calgary's special transportation services. Although informal talks with the Province regarding this matter have taken place, they have not progressed far enough to identify the actual impact on the City's transportation programs. It is evident however, the existing service levels and budget will not meet the expected increased demand. Existing service levels will have to be increased or alternative service delivery systems created.

Aging Population

Calgary, although experiencing rapid percentage gains in its younger population, has not historically seen this same growth in the seniors population. Although the absolute number of seniors has increased in Calgary, the growth was balanced by the immigration of younger people. This trend is now projected to change. As Calgary's population stabilizes, the percentage of seniors in the population will increase. Projections indicate that the number of people in Alberta who are over the age of 65 will double by the year 2001.

The fact that people are living longer has important implications for service providers. It is becoming apparent that it is important to keep seniors in the community as long as possible. The elderly of the future will also be healthier, more independent, and better educated. Services that today's seniors view as a privilege, tomorrow's seniors will demand.

CONCLUSIONS

There is little question that the demand for special needs transportation services, in Calgary, will increase in the future. Since the major funding source for Calgary's special transportation programs is the municipal tax base; it may also be assumed the program budget increases necessary for expanding the transportation programs, will be hard to obtain. Therefore it is not to soon for the City to be exploring alternative funding sources and alternative transportation delivery systems. New policies and directions must be developed for satisfying the transportation needs of a growing community of functionally disabled individuals.

Directions and alternatives that should be explored by the City of Calgary for the future provision of special needs transportation include the following options.

1. Pursue more equitable cost sharing with the federal and provincial governments for special needs transportation programs.

2. Pursue alternative funding sources for special needs transportation programs (e.g., Canada Assistance Plan funding).

3. Move as many Handi-Bus users as possible to the Special Needs Taxi Program. The cost for the average one-way trip on the taxi is 58% less than the average trip on Handi-Bus.

4. Establish fixed route systems for specific geographic areas in the city in which larger concentrations of functionally disabled individuals live.

5. When Provincial policies impact upon the provision of special needs transportation services (e.g., deinstitutionalization), special agreements should be entered into whereby additional funding is provided by the Province.

6 Develop programs for assisted vehicle conversion and ownership which in turn would increase disabled user mobility while removing people from city-funded transportation programs.

7. Encourage multiple ownership and usage of vehicles by seniors and disabled individuals who live in close proximity to each other. The program identified in option six could be used for vehicle purchase and conversion.

8. Develop programs whereby group homes, nursing homes, etc. provide their own transportation services. Grants for the purchase of vehicles could be used and operating costs would become part of the operating budget of the facility.

9. Support volunteer groups efforts where services include providing transportation for functionally disabled individuals by volunteer drivers who use their own cars.

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TRAVELLING DISADVANTAGED
AND
THE ADVANCED LIGHT RAPID TRANSIT SYSTEM
IN VANCOUVER, B.C., CANADA
A REPORT ON THE ACCESSIBILITY ISSUES

Prepared by
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TRAVELLING DISADVANTAGED AND ADVANCED LIGHT RAPID TRANSIT SYSTEM IN VANCOUVER, B.C., CANADA:
A report on all the accessibility issues.

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The advanced light rapid transit (Skytrain) is one of the most accessible rapid transit systems in the world. The early policy decision for a barrier free system and a broad definition for travelling disadvantaged (T.D.) insures that the stations and vehicles are barrier free to the limit of system technology. Skytrain is fully integrated with the bus system and since the visually impaired rely on the bus system for transportation to employment, special provisions were made for the visually impaired.

Skytrain is designed to be barrier free and also incorporates accessibility concerns in operations, education, safety and emergency procedures. Skytrain is one of the few systems with extensive safety and emergency policies specifically designed for the T.D. The provisions include areas of refuge in the underground stations, extensive education programs for the public, staff and emergency response personnel on how to assist the T.D. patron in an emergency.

Operational issues relate to the system wide safe movement of the T.D. and how they accommodate the technical constraints such as vehicle size, and platform - vehicle interface. System signage, public and emergency information and communication is an integral part of safe operations.

The education program addresses the operational, safety and emergency issues for both staff and the general public. The staff program orients the staff to the needs of, and how to approach and offer assistance to, special travellers. The public education program concerns the needs of the T.D. in general. All education programs focus on safety and emergency issues.

All the accessibility issues of the first stage of skytrain have been compiled in a

report that serves both as a summary and recommendations for design changes for future phases. The initial revenue operations of Skytrain have indicated the features that have been well done and those which need further work. For example, the tactile treatment of stairs and handrails have been very well done, however the tactile edge strip requires further research.

The major recommendations are to research and recommend an alternate platform edge strip material and to maintain the high quality of provisions for the visually impaired on the stairs and handrails.

TRAVELLING DISADVANTAGED
and
THE ADVANCED LIGHT RAPID TRANSIT SYSTEM
in Vancouver, B.C., Canada.
A REPORT ON THE ACCESSIBILITY ISSUES

1.0 Introduction:

The advanced light rapid transit system (Skytrain) is one of the most accessible rapid transit systems in the world. Accessible refers to the barrier free access to the rapid transit system for the elderly and handicapped. Accessibility is not merely design but incorporates operations, education, safety, and emergency procedures. The design, operational, and educational features are presented in this paper. The Vancouver Regional Rapid Transit project (Skytrain) was initiated by the B.C. Provincial Government in 1980. Construction began in 1982 and the Phase I went into revenue service January 1,1986. Skytrain had a capacity of 6,000 passengers per hour when it opened in 1986 and after Expo 86 it will have a capacity of 10,000 passengers per hour. Ridership averaged 50,000 passengers per day in March 1986.

The rapid transit technology is Canadian, and eveloped by the Urban Transportation Development Corporation of Ontario (UTDC). The computer-controlled Intermediate Capacity Transit System (ICTS) is highly flexible and able to respond quickly to changing passenger volumes. The system consists of automated aluminum cars which travel on standard-gauge steel rails on a dual guideway, one track for each direction, fully separated from traffic. Figure 1 is a Map of the Skytrain Route through greater Vancouver. Most of the 21.4 km Phase 1 line between downtown Vancouver and New Westminster is elevated between six and eight meters above ground.

Linear Induction Motors(LIM) propel each Rapid Transit vehicle. These motors react with a continuous steel and aluminum plate set in the middle of the tracks, and a magnetic force pulls the cars along. The LIM do not use gears or transmissions and are independent of the wheels and axles. They also act as a primary braking system regenerating energy for use by other trains.

A unique feature of the system is a steerable axle truck, also a Canadian developed

FIGURE 1 - Skytrain Route through Greater Vancouver

system. This design eliminates flange contact with the rail, improves ride quality, substantially reduces noise, including wheel screech on curves, and creates maintenance savings by extending rail and wheel life.(1)

The capacity of each Rapid Transit vehicle is for 40 seated passengers and 35 plus standing passenges. Figure 2 illustrates the vehicle layout. The maximum speed of the vehicles is 90 kilometers per hour. The vehicle is powered by a 650 VDC line, which is converted to variable frequency and AC voltage for the Linear Motors. The brakes use both dynamic and regenerating electric brakes via the LIM motor plus magnetic track brakes and hydraulic disc brakes which also serve as parking brakes.

A computer train control system directs the movement of trains in the system, constantly checking the speed, direction and location of all cars on the line. Rapid Transit staff monitor and control the computer system at all times. Based on the SELTRAC moving block concept of SEL Canada, the system consists of three computer systems. The system management centre is a dual computer which, under the direction of human operator, carries out supervisory functions such as scheduling, rerouting, system start up and shut down, emergency procedures, and so on. The vehicle control centre consists of three linked computers with responsibility for safe train movement. It communicates with each train and receives instructions from the system management computer. The third element is the vehicle on-board computer, which receives and verifies commands from the vehicle control computer and issues safe instructions for propulsion and braking, door operation and coupling. The computer also monitors on-board equipment to detect problems before they create delays. The SELTRAC train control system is in operation on parts of the German Federal Railways and on Line 4 of the Berlin Subway. It meets the very conservative safety standards mandated by German Railway and Transit regulatory authorities.

Uniformed operating staff, equipped with two-way radios will be present at all times, roving through trains and stations to insure security and to provide information and assistance. They will make spot checks for tickets and handle supervisory tasks.

Vancouver's Skytrain will be the heart of the Lower Mainland's Transit System, closely integrated with the buses, Handidart (paratransit), and Sea-Bus. Major stations will have bus loops and bus routes will be re-organized to feed into the line, bringing passengers to stations to continue trips downtown or to one of Greater Vancouver's

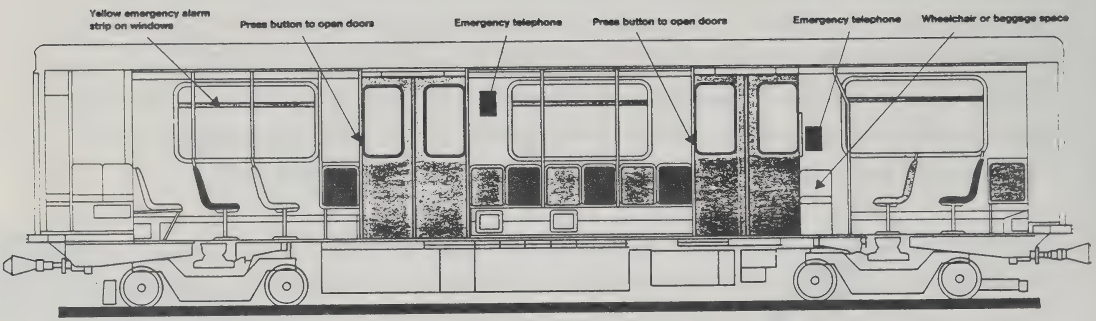


FIGURE 2 - Vehicle Layout

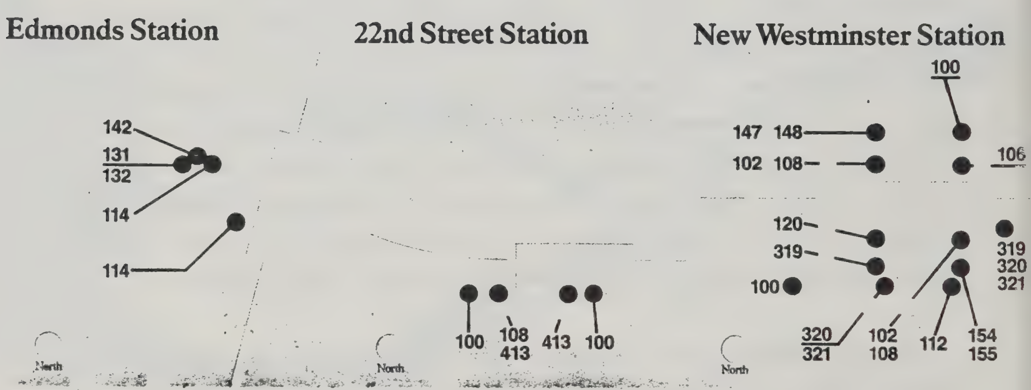


FIGURE 3 - Station Locations and Connecting Bus Routes

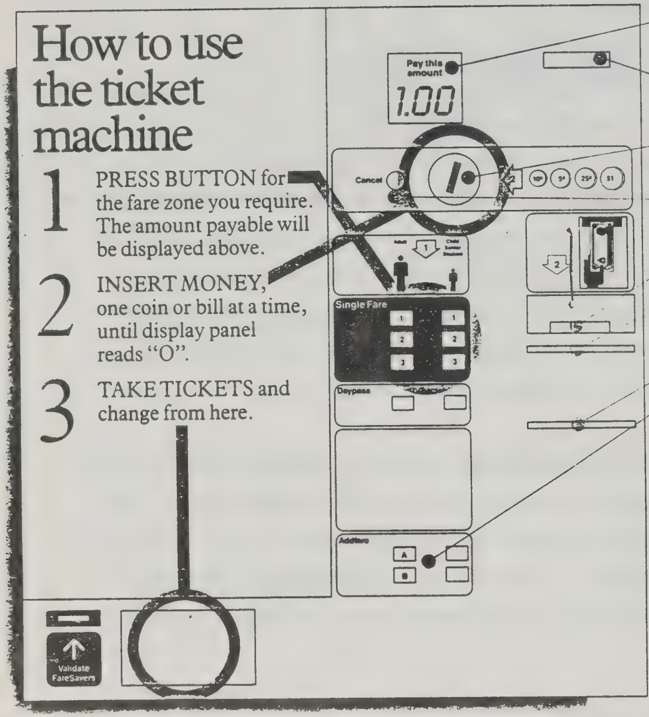
regional town centres. Figure 3 shows several station locations and their connecting bus routes. Rapid Transit will mean shorter travel times in the region. Instead of boarding a bus in Surrey or Coquitlam for an hour long ride to downtown Vancouver, commuters will transfer from their bus at New Westminster to the Rapid Transit line. Now Phase I is operational, planning for extensions across the Fraser River are underway. Skytrain is an integral part of the bus transit system therefore 80 percent of rapid transit users inbound are transfer passengers, almost half of all passengers use farecards or prepaid tickets. Figure 4 is a schematic of the ticket machines used by non pre-paid passengers.

2.0 DESIGN CONSIDERATIONS

An Overall System Design (OSD) policy was adopted for the Skytrain, and specifications for a "Barrier Free" transportation system were incorporated into the OSD. An OSD policy, through functional commonality, provides consistent design, construction and procurement for station features. Skytrain was designed to be "Barrier Free" as a result of a decision by the Provincial Government during the preliminary design phase. The adoption of the OSD and the barrier free policy permitted accessible design features to be adopted system wide.

At the outset it should be realised that although the system is "Barrier Free" it is not totally accessible. Skytrain is accessible to the extent that is reasonable for a rapid transit system. It should also be made clear that the Handidart Bus system, which is a demand responsive paratransit bus system, will still be available as an alternative and for most severely disabled individuals it will provide more convenient service than Skytrain.

During the intial design phase it was foreseen that there were design conflicts between features that benefitted one particular user group and were hazardous for other user groups. For example, ramps can be hazardous for the visually impaired and a benefit for wheelchair users. An objective resolution for these conflicts was desired. In general, persons who are visually impaired depend on regular public transportation for commuting to and from employment and do not have the option of driving their own vehicles, whereas most persons who are mobility impaired either drive themselves or use demand responsive transportation, therefore design conflicts concerning these two user groups were resolved in favour of the visually impaired.



Machine status display. If it shows:

Green	**Pay this amount**	according to instructions.
Orange	**Sorry no change**	pay exact fare only.
Red	**Not in service**	please use another machine.

Shows **Coins only** if banknote acceptor is out of service. Machine will then accept coins only.

Coin slot for 5¢, 10¢ and 25¢ coins only. Pennies and 50¢ pieces, plus any bent coins, will be returned in the ticket dispenser.

Cancel button will return money inserted. Also use to reject damaged coins.

Banknote slot for $1, $2 and $5 bills only. Insert as shown, head upwards and forward.

Return slot for banknotes that are wrongly inserted, badly soiled or worn. Insert the note correctly or try another note.

Return slot for notes when you cancel.

Addfare selection buttons – for adults with FareCard or FareSavers in peak hours only. Press button "A" to buy an Addfare for one additional zone, or button "B" for two more zones. Retain Addfare with your FareCard or FareSaver for inspection. Valid until time shown. NOT VALID FOR A RETURN TRIP.

Problems and Solutions

Machine "Not in Service." Please use another machine. Do *not* ride without paying fare.	**Coins returned.** Use coins that are not bent or badly worn.
Notes not accepted. Use coins in place of banknotes.	**Notes returned.** Use only clean, undamaged Canadian notes.
No change. If machine runs out of change, please pay exact fare in coins and/or notes.	**Refunds.** See detailed information on page 12 of this brochure.

FIGURE 4 - Schematic of Ticket Machines

2.1 STATIONS

The stations were designed and constructed in accordance with the provicial, and city building codes; however, these codes were not adequate for all the requirements of station design. A new Code was developed incorporating the provicial and city building codes as well as specifying special design provisions for the stations (3). The stations function to move patrons between transportation modes and therefore have special design requirements which are not necessary for regular buildings.

2.1.1 Drop Off Sites

Handidart bus patrons drop-off and pick up sites have been located as close to the main entrances and exits of the stations as possible, or near the elevator access if the elevator is remote from the main entrance. Where possible, efforts were made to locate the drop off and pick up sites for the disabled on the same side of the road as the entrances and exits and in a safe position with respect to all other traffic.

2.1.2 Doors

Station doors exist at only 3 of the 15 stations. They are easy to open and have minimum resistance; however, all stations have rolling grills that are open when the system is operating. There are no revolving doors in any of the stations.

2.1.3 Foyers

The station foyers are paved with hard materials that are durable and easily cleaned for example terrazo or brick pavers. However, the hard surfaces create acoustical problems for the visually impaired who rely on auditory feedback for guidance. In some stations the texture of the floor material is so rough that it causes the guide canes used by some of the visually impaired to bounce and giving confusing tactile information about orientation and obstacles.

2.1.4 Elevation Changes

Three methods are used to handle elevation changes and these include:

1. Stairs and Handrails - All Stations are equipped with stairs and most have escalators. At the top of all flights of primary access stairs and (intermediate landings intercepted by paths of travel), there are ribbed rubber tactile warning strips of one tread width back and one tread width wide on the floor and segments of roughened handrails indicating the presence of a flight of stairs for the visually impaired. The first and last stair in each flight of interior stairs have contrasting black nosings to indicate the beginning and ending of a set of stairs. All exterior flights of stairs have contrasting nosings on every stair. In all stations, with the exception of Granville and Burrard, the stairs are parallel to the escalators. Burrard and Granville are both deep underground stations and the stairs provide emergency but not regular access and egress. In general, the elderly and disabled do not use escalators due to the tripping hazard when getting on and off escalators.

2. Elevators - All stations are equipped with elevators, with the exception of Granville Station. However, in the future, when development around Granville Station goes ahead, there will be an opportunity to add elevator access to this station. All elevators are monitored by closed-circuit television, and have intercoms built into the Call Button. All elevators are equipped with the Handicapped control package. For security reasons some elevators will be locked at night but can be unlocked remotely by central command when requested on the intercom by the Call Button and verified by the closed circuit television monitor that the request is legitimate.

3. Ramps - Ramps are only at stations where there is an elevation change between the drop off site and the station entrance. There are no interior ramps.

2.1.5 Communication

The basic signing system has been designed for high visibility in changing light conditions. Dynamic sign units are provided at platform level for train and emergency information. Also there are public address systems on the platform and at other key locations in the stations. Systems provided insluded:

1. Station Information Systems - In entry halls and at the platform level, information displays are provided indicating system use, emergency procedures, system map, local area map and bus system map.

2. Station Signage - International signage standards for the travelling disadvantaged have been incorporated into the station signage. A special sign denoting the Handicapped refuge area has been developed for use on Skytrain. Figure 5 shows the area of safe refuge symbol.

2.1.6 Telephones

There are wheelchair accessible public and information telephones at the concourse level and emergency telephones to Central Control at all levels and on each vehicles. Figure 6 illustrates the emergency telephone cabinet.

2.1.7 Fare Collection

There are no turnstiles or ticket collectors; however spot checks are carried out by uniformed and ununiformed transit staff. Accessible fare machines, which accept either coins or bills and provide change, and ticket validators are located in every station entry. Passes, transfers, and validated tickets all serve as proof of payment. Figure 7 illustrates some of the tickets that are used on Skytrain.

2.1.8 Station Furniture

All station furniture is consistent in design and construction throughout the entire

FIGURE 5 - Area of Safe Refuge Symbol

Telephones

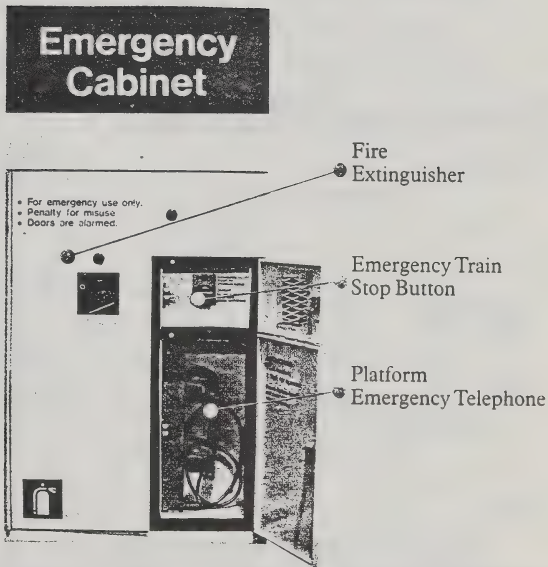
The SkyTrain system is equipped with four types of telephones:

1 PLATFORM EMERGENCY TELEPHONES –located inside the Emergency Cabinet on station platforms–these red telephones provide direct connection to the Control Centre for use in emergencies only.

2 INFORMATION TELEPHONES–located at all station entrances–these white telephones offer direct access to Transit Information for schedules, services and connections.

3 PUBLIC PAY PHONES–are available at all station entrances.

4 VEHICLE EMERGENCY TELEPHONES –inside every SkyTrain car–provide two-way radio contact with the Control Centre for passenger aid or emergency medical assistance.

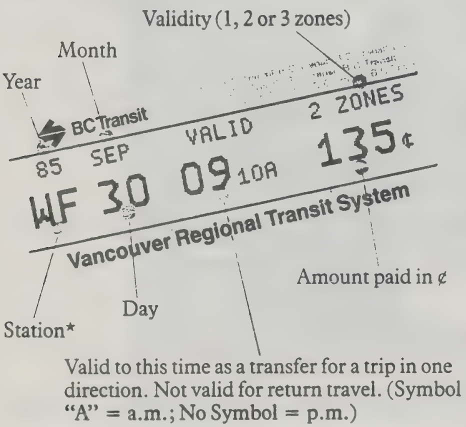


Please note: BC Transit regulations apply severe penalties for the misuse of emergency telephones or other emergency equipment.

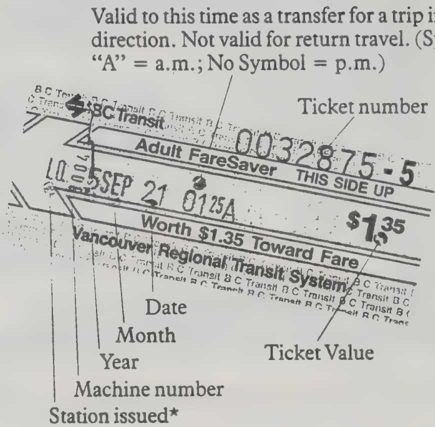
FIGURE 6 - Emergency Telephone Cabinet

How to read your ticket

Single Ticket



FareSaver Validation



Station Code

*LQ	=	Lonsdale Quay
WF	=	Waterfront
BU	=	Burrard
GV	=	Granville
ST	=	Stadium
MN	=	Main Street
BW	=	Broadway
NA	=	Nanaimo
TN	=	29th Avenue
JY	=	Joyce
PT	=	Patterson
MT	=	Metrotown
RO	=	Royal Oak
ED	=	Edmonds
TS	=	22nd Street
NW	=	New Westminster

FIGURE 7 - Illustration of some Skytrain Tickets

system. This means, for someone visually impaired, that when they detect a station seat they know how many seats there are and where the ash tray and garbage bins are spatially located. The furniture placement is uniform on all centre platforms and all side loading platforms, which is consistent in all stations with similar platform arrangements throughout the system.

2.1.9 Location of Areas of Refuge

The grade and above grade stations are essentially open areas free from accumulation of heat and fumes so no areas of refuge are specified. In case of emergency, it is left to the discretion of the disabled patron to either follow the evacuation procedures along with other patrons or to remove themselves to a safe area at either end of the platform out of the stream of traffic and wait for assistance. Where stations are integrated with other buildings to such a degree that they are enclosed spaces then areas of refuge are provided and appropriately indicated.

2.1.10 Platform Configurations

All stations are designed with either side or centre loading platforms that are long and narrow. All platforms are 80 meters long, centre loading platforms are 7 meters wide and side loading platforms 3.5 meters wide. Each platform has safety edges and warning strips setback from the quideway edge of the platform. The safety edge is 400mm in width and contrasts in texture and colour with the surrounding floor material. The warning strip is 100mm in width, yellow in colour and constructed of a material that is readily discernable by texture. In some stations, the paving tiles of the platform are uneven, and as a result the smooth edge of the platform is more easily detected by cane than the tactile strip.

2.2 VEHICLE - PLATFORM INTERFACE

2.2.1 Gap Width and Height

The Skytrain vehicles are not self levelling. All rail vehicles sway and consequently lateral clearances are required; this is also called the dynamic envelope. The typical height difference between the platform and the vehicle is 25mm or less, and the typical gap width is 50mm. The gap between the platform and the vehicle is a technical constraint of rapid transit. Skytrain has one of the narrowest gaps in the industry but may still restrict accessibility for some passengers.

2.2.2 Door Opening Button

The tactile door button is located at the centre edge of the door at approximately one meter in height. The vehicle doors do not open automatically to conserve energy. The visually impaired and wheelchair users must learn how to press the door opening button and then enter the vehicle. The door opening procedures could prevent some of the travelling disadvantaged from using Skytrain independently, there are usually sufficient staff circulating on the system to provide assistance on request.

2.3 VEHICLE LAYOUT

The location of wheelchair and travelling disadvantaged seats on all Skytrains made up of one, two, and three married pairs, are always be at the centre of the married pair. Wheelchair patrons are encouraged to use the front vehicle of a married pair because the screen structure provides support in the unlikely event that the emergency brakes are applied. Orientation of the wheelchair is at right angles to the direction of travel, and warning signs are posted that all wheelchairs must have functioning brakes and the brakes must be applied when the train is in motion. Consultation with representatives of the disabled community as well as other accessible rapid transit systems determined that tie downs were not necessary and would make independent travel very difficult.

Guide dogs are permitted on the vehicles and sit in the wheelchair position if there are no wheelchairs on board, otherwise they sit in the aisle. The button for door opening is located on the stanchions near the wheelchair space and the seats for the travelling disadvantaged and can be accessed by the person in the wheelchair. Stanchions and overhead rails are provided for standing patrons to hold on to when the train is in motion. Figure 8 illustrates some of the vehicle features for the travelling disadvantaged.

3.0 OPERATIONAL FEATURES

3.1 Technical constraints

The major technical constraints on accessibility are the gap height due to the non levelling vehicles and the gap width due to the dynamic envelope. The tolerances on Skytrain are some of the smallest in the world. Some non conventional wheelchairs with very small diameter wheels have trouble with the gap.

3.2 System Signage

Vancouver is a very cosmopolitan city with a large number of immigrants who do not speak english or french and are considered functionally illterate. The system signage, which was developed to convey important system information, uses interntional symbols and pictorial representations as much as possible. For example, pictorial representations are used to explain how to use the fare machines.

3.3 Washrooms

Skytrain is an extension of the regional bus system so public washrooms were not provided. Staff washrooms are provided and these are accessible washrooms in most of the stations. The washrooms are for the staff, however the disabled may also use the washrooms after they have contacted a Skytrain employee.

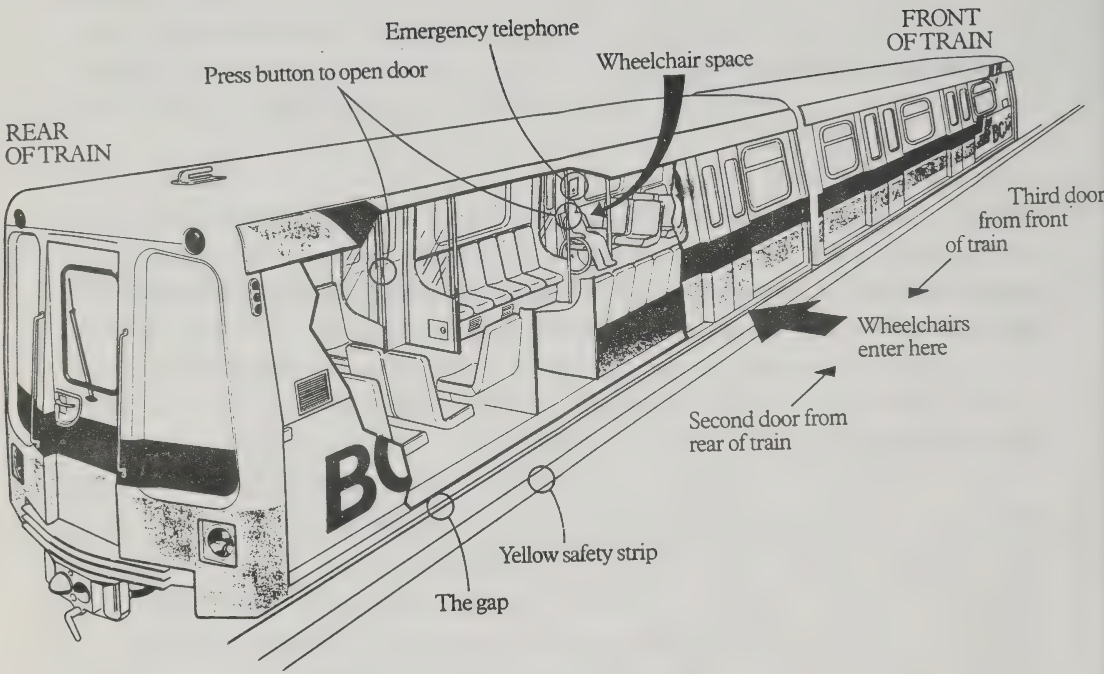


FIGURE 8 - Vehicle Features for the Travelling Disadvantaged

3.4 Emergency and Safety

The areas of refuge in the underground stations were designed as an integral part of the station design. Special procedures were written for emergency evacuation and general safety of elderly and handicapped patrons. These procedures were incorporated into the training programs for the staff, emergency response personal(ERP), and general public. All system safety and emergency activites are coordinated through central command. Central command can contact any station or vehicle through the public address system or vehicle intercom. All stations are monitored by closed circuit televisions. Command Central can listen in on activities on the vehicles to assist in an emergency. An emergency yellow strip is fitted into each vehicle and in an emergency it will send an alarm to command central.

4.0 EDUCATIONAL FEATURES

4.1 Public Relations Information

Special public relations materials were written for the travelling disadvantaged. A copy of the brochure, Skytrain Companion. General public information also includes information about courtesy towards the elderly and handicapped passengers. The brochure answers many of the questions and eases many of the concerns that elderly and disabled patrons have about riding Skytrain.

4.2 Staff

The train attendents received special training on how to approach and offer assistance to passengers with special needs. Part of the training was presented through a video which was written specifically for the purpose of raising the level of awareness of the staff to the obvious and hidden needs of the elderly and handicapped.(4) The attendants who have first aid as part of their basic training were also given a course in wheelchair management, lifts, carries and transfers. They were also instructed how

to assist a person into a wheelchair from floor level, this is useful for assisting a passenger who has fallen out of a wheelchair. Appendix A includes examples of the training materials that were developed for the staff training program.

4.3 Public

A public education program was carried out through a series of free weekend open houses and train rides at selected stations as well as one month of free service before the system opened for revenue service. The public education program for the elderly and handicapped was carried out through a series of information seminars for representatives of the disabled community and agencies. These representatives were then responsible for informing and training their members on the specific details that are required for them to use the system. The rationale behind this approach was that the information and training would relate to each users particular needs. The visually impaired were given extended oppportunites for mobility training prior to start up. A train was parked at a side track one afternoon a week for four months prior to revenue service and mobility trainers and their visually impaired trainees were able to orient themsevles to the station, vehicles, and the system in general.

4.4 Emergency Response Personnel (ERP)

The ERP receive ongoing training on the system, as well as initial training on the evacuation of mobility, hearing, and visually impaired patrons. Skytrain is one of the few systems where attention has been paid to the safety and emergency needs of the elderly and disabled.

5.0 DISCUSSION OF OUTSTANDING ISSUES - Phase 1

Phase I is now complete and planning and design for future phases is underway. Many lessons were learned from the prebuild operation during the summer of 1983, and many more lessons will be learned during the first year of operation of Phase I. It is the intent of this discussion to highlight design features that were well done and should be incorporated in future phases as well as those features that need changing

in future phases. There will be many more design issues that will arise during the first year, but several serious design shortcomings appeared during the open houses prior to revenue service.

5.1 Platform Edge Strip

In many stations the platform surface masonry is very rough and at one station, the end of a guiding cane broke off due to the rough surface. The edge strip which was recommended by the Canadian National Institute for the Blind (CNIB) is inadequate given the texture of the surrounding platform. Materials on the edge strips used in Japan have been suggested as alternate materials for the edge strip for Phases II.

5.2 Acoustics

Station acoustics were considered in all stations, and certain acousitcal treatments were followed. Most of the grade and above grade stations are open air. Stadium station is partially covered with glass. At the bottom of the stairs leading to the platform the roof line is curved with the result that the sound reverbereates and is distorted so that it is difficult for the visually impaired to orient themselves to platform centre line and direction. Acoustics in the should be given greater consideration for Phase II stations.

5.3 Telephones

The information telephones are at the maximum height that is acceptable by the building code. Functionally the telephones are too high. Phase II information telephones should be lowered to 1100mm, however this lower height interfers with the overall system design carrier rails and may be impractical.

5.4 Handrails

The handrails are placed at the minimum height (860mm) of the building code, while

recommendations in the new building code and from research recommend that the handrail should be at 1000mm. The tactile treatment of the handrails at the top of stairways, and the tactile treatment of the stair nosings have been very well done and should be continued in Phase II.

5.5 Vehicles

The vehicles are a given technology and few changes can be made to inprove the accessibility of the vehicles themselves. Visually impaired patrons and wheelchairs do not mix very well and therefore the visually impaired should sit in a seat away from the wheelchair space when a wheelchair is present. In general the visually impaired prefere the wheelchair seat.

6.0 CONCLUSIONS

Vancouver's Skytrain is one of the most accessible rapid transit systems in the world. This is primarily due to the initial policy decision for a "Barrier Free" system and the attitude of the project designers. Accessible design is more than providing elevators in the stations it is also an attitude of mind. Everyone who travels on Skytrain benefits from the special provisions for the travelling disadvantaged.

The major features that contribute to the "Barrier Free" system are: consistent design for furniture and station features, integration with the Paratransit service, elevators, safe stairs and tactile handrails, areas of safe refuge in the underground stations, tactile edge strips, small tolerances on the gap width and height, and extensive public and staff, education and safety programs, and above all an attitude by the public and staff that is "Barrier Free".

7.0 RECOMMENDATIONS

The recommended design modifications for Phase II development include further investigation of:

1. the platform edge strip and safety strip, to find a material that is more easily detected by cane and still provides a high contrast with the platform floor,
2. consideration of acoustics in the grade and above grade stations so that the reverberations do not distort the direction of sounds,
3. lower information telephones, for easier access for wheelchair users,
4. continuation of tactile treatment of stairs and handrails and raising handrails to 1000mm the current design of the stairs is very good.

8.0 REFERENCES

The British Columbia Building Code Section 3.7, Building Requirements for Person with Disabilities, Code and Handbook, 1984, Victoria B.C.

Building Code Equivalencies for the Design and Construction of Station Facilities, Vancouver Regional Rapid Transit, October 1984,

Public Relations Materials, published by the Vancouver Regional Rapid Transit Project 1981-1985

"Reaching Out", Videotape for staff orientation and sensitivity towards elderly and disabled passengers.

APPENDIX A

Staff training materials

EDUCATION PROGRAM

PART A STAFF EDUCATION PROGRAM

1. SENSITIVITY TRAINING

1.1 Introduction

The goal of this program is to create fair and open expectations and help overcome fears and apprehensions about aiding the disabled. The passenger with special needs is an individual whose needs must be met in a different way from those of most people. The passenger does not need pity. When you pity people with a disability, it makes them feel devalued. Most people would prefer respect "like everyone else."

Your passengers are not all alike. People with disabilities have the same wide variety of skills and personalities that other people have. People with disabilities are unique individuals -- not just catagories. Some individuals you may like, and others you won't. Some of your passengers will like you, and others will not.

All people with disabilities come by their disabilities in a unique fashion, although in this program we will be lumping and generalizing on many of them, you must remember that each passenger you help is an individual. A permanently disabled passenger is not sick. A person with a disability can become sick, like anyone, but the disability itself is not an illness to be cured. Some temporarily disabled persons may have illnesses such as heart disease or be pregnant or suffer a broken limb. Most people who have some disability are as healthy as people who have no disability.

Your passenger is not incompetent. A person with a disability is usally able to get around and do everyday tasks. In many ways, the biggest handicap that disabled people face is inherent in the attitudes and expectations of others. If disabled people have problems coping, it is because they have generally been segregated and must overcome the architectural inaccesssability of most public facilities. But many people with disabilities do get around and can cope, despite the barriers. Your passenger's disability is not contagious. Many disabilities are evident at birth or soon after and reflect a genetic abnormality (e.g., spinabifida), prenatal trauma (e.g., german measles), or are the result of the birth experience (e.g., blindness, cerebral palsy); also, disabilities are results of accidents or illnesses after birth (e.g., spinal cord injuries, aputations, polio, and severe emotional trauma.)

1.2 Assisting

Treating each disabled person as an individual is essential and results in the most effective assistance. Disabled people think of themselves as people first and disabled second, and so wish to be assisted in the same way that you would assist any passenger -- with concern, respect, dignity and understanding. Your passenger requires understanding. Assess the problem to the best of your ability. Learn to recognize the symptons and limitations of particular disabilities. Determine the passenger's ability to stand, communicate, walk, or manoeuvre a wheelchair; whether pain, stiffness or weakness is a factor; and the degree of caution you must take. If a person has a verbal disability, it may take the individual longer to say a sentence, and it may take a concerted effort on your part to understand what he or she is

saying. Take your time to understand and appreciate the problem, and if you do not understand, do not be embarrased to say so.

Your passenger needs your willingness to assist if required. Introduce yourself and offer assistance. Should your initial offer be rejected, do not hesitate to repeat it later. Do not be offended if your offer is refused. Usually, disabled people will ask you when they need help and can tell you the best way to provide it. Listen to what they have to say. When we are confronted with people who are obviously disabled, we may embarrased and unsure. When you say "I do not know how to help him because he is blind," you have already assumed that you have to treat him differently. You have shut down the two way relationship. Concern yourself with the person's needs, not yours! Your passenger has dignity. Assist disabled persons when necessary or requested, but do not discourage their active participation. The disabled traveler is usually more familiar with the best techniques of providing assistance; for example, the best way of handling stairs and being transferred to and from a wheelchair. Be aware of what disabled people cannot do, and more importantly, what they can do. Allow them the dignity of doing what they can do by themselves. Your passenger deserves respect.

Be gentle, reassuring and respectful. Let your passenger know exactly what you are doing, every step of the way. Naturalness, real kindness, and an inherent human respect is the most successful contact. Avoid "overdose" of assistance, which makes a handicap more noticable, damages the value of your relationship with the passenger, and lowers his or her respect and self esteem.

1.3. Overview of Common Disabilities

1.3.1 Orthopaedic Disabilities

Orthopaedic Disabilities refer to injuries of the bones, muscles, joints, and ligaments. Also fractures, amputations and arthritis are often in this catagory.

1.3.2 Neurological Conditions

Neurological Conditions concern the brain and central nervous system. Cerabal palsy, spinal cord injuries, polio, multiple sclerosis and muslar dystrophy are in this category.

1.3.3 Spinal Cord Injuries (SCI)

Spinal Cord Injuries are usually classified as paraplegic or quadraplegic. A paraplegic is affected from the waist down, and quadraplegic is affected in the arms as well as the trunk and legs. In general both paraplegics and quadraplegics have incomplete sensation below their lesion level and they cannot feel a blow or undue pressure, and as a result, they can injure themselves and not be aware that anything has happened. This is particularly important when a person is transferring, because they may not realize that they are injuring their buttocks.

1.3.4 Multiple sclerosis (MS)

MS is the most common neurological disease of the central nervous system. The symptons and effects of MS vary greatly according to the severity and the course of the disease. Some people may have only one or two attacks and then be sympton

free for the rest of their lives. In others, the disease may follow a slow, progressive course with no remissions. The implications of MS are that the body functions may become uncontrolled because messages are not transmitted correctly or are sent to the wrong body part. This can result in symptons ranging from slurred speech to loss of coordination and bladder and bowel control. Some people suffer pain while others do not. Some people lose weight or become physically weak and require electric wheelchairs. Fatigue, which results from damage to the nervous system, is one of the least understood and most frequent symptons of MS. The degree of fatigue can fluctuate daily, and the person with MS may find this hard to cope with. A person with MS may continue to function normally for many years after the initial diagnosis. When the course of the disorder is in remission, or only slowly progressive, many persons can make gainful vocational adjustment and can remain relatively self-sufficient for many years. MS is not contagious. MS does not have a cure and the causes are unknown, although suspected, it is much more likely to be a hereditary and environmentally based disorder.

1.3.5 Cerebral Palsy (CP)

CP is not a disease, but a medical term used to describe a number of musclar dysfunctions. It is a non-evolving, non-progressive, stable condition, characterized chiefly by disorders of motor functions and presumably caused by damage to the part of the brain that controls and coordinates muscle action before, during, and shortly after birth. Persons with CP may exhibit stiff arm and leg movements, staggering gate, involuntary motion of limbs and difficulty in speaking, chewing or swallowing. There are general problems in controlling, carrying out and coordinating voluntary movements. Persons with CP can be slightly or severely affected by the condition and can have impairment in one bodily function or many. One person may have an impairment in the extremities so severe that independent ambulation is not possible. Another individual may have just a slight speech impairment or a disorder that is apparent only in circumstances calling for good manual dexterity. There are three recognized types of cerebral palsy: Ataxia, characterized by a loss of equilibrium when walking or standing and difficulty in directing movements of the lip and tongue; spasticity, resulting in musclar contraction or rigidity, which, inhibits voluntary motion; and tremor, which causes uncontrollable, involuntary motions. Persons with CP do not always need assistance. Those with CP are bound to face many frustrations and disappointments in choosing activities or in realizing aspirations. Affected persons, however, have usually gone through an extensive rehabilitation process that has equipped them with alternate methods of performing daily tasks. It is easy to assume that because people with CP may exhibit paralysis or uncoordination and speech difficulty, they are less capable and more dependant than they actually are, but because they have often perfected adaptive movements, their capacity for performing a specific task may be uneffective by their disability.

1.3.6 Arthritis

Arthritis is a disease that affects the entire body, but usually involves inflamation of the joints. The three most common types of arthritis are: rheumatoid arthritis (RA), osteoarthritis (OA), and gout. Pain, stiffness in joints, muscle weakness and fatigue are all symptons of rheumatoid arthritis. The hands and feet are the areas most commonly affected and can become deformed. Osteo arthritis effects joints, especially in the hips, spine and knees. Gout is a hereditary form of arthritis marked by an excess of uric acid in the blood and by recurrent, sudden arthritic attacks on a single joint. Arthritis is not always visible, and is not necessarily accompanied by deformed joints and outward signs of disability, but people with arthritis can have extreme

pain and discomfort. There are other forms of arthritis that effect internal organs, and visible manifestations are not evident.

1.3.7 Epilepsy

Epilepsy is a sympton, not a disease. Manifestations of epilepsy range from momentary black-outs to tremor attacks or seizures. These seizures can be as brief as five to thirty seconds and can vary from slight to severe depending on the individual. There are great variations in seizures, but there are three common types; grand mal seizures result in convulsions, muscle spasms, and loss of consciousness. Duration is usually no longer than three minutes, but the person may not regain consciousness for several minutes longer. Petit mal seizures result in loss of contact by the individual with his or her immediate surroundings for a few seconds. The seizures can occur frequently and the individual appears to be only daydreaming. Psychomotor seizures have the most complex behavioral pattern in persons experiencing an attack. Outward indications range from picking at clothing to aimless wandering to looking "spaced-out."

1.3.7.1 Assisting a passenger having an epileptic seizure:

Do not panic if your passenger has an epileptic seizure while traveling, although seizures may look painful, they are not. Generally, it can be helpful if you time the seizures, observe the affect, and provide this information to the person when he or she has fully regained consciousness.

Grand mal seizure - let the seizure run its course. When the passenger regains consciousness, he or she may be confussed and not remember what happened. The passenger will first need to rest; in many instances if this is not done, a subsequent seizure may occur within a few minutes. If unaccompanied, the passenger should be left in a safe place with a responsible person until well enough to continue the journey.

Petit mal seizure - no special care is needed in the event of a petitmal seizure, just be aware that the person may not hear you if you speak during the seizure.

Psychomotor seizure - when this type of seizure occurs, do not restrain the person in any way unless it is essential for the individual's personal safety. Stay with your passenger. This could mean having to follow the passenger to remove any obstacles that may be encountered. Although disoriented, the person is usually ameanable to suggestions made in a pleasant and friendly manner. Speak calmly and quietly to see if the person responds. He or she will be confussed after this type of seizure and will not remember what happened during it. Encourage the individual to resume normal activities.

1.3.8 Visual Impairment

Recognizing persons with perceptual limitations requires a thorough understanding of blindness, which does not always mean total loss of sight. Sometimes the person who is "legally blind" can see a little. Some persons can distinguish only the difference between light and darkness; others see in a mist as if a thick white curtain were always in front of their eyes. Still others have peripheral sight, seeing the world around the edges of a great dark mass in the center of their eyes. They never see a

whole shape, but only the top and bottom or the ends. Another group has pin-hole sight, with everything blocked off except a tiny speck of light.

People can be born blind, or can become blind through accident or disease. Blind individuals most commonly use sighted guides, canes, or dog guides when traveling. The choice of aid is personal, and based on the individual's needs, lifestyle, and abilities. A group of newly developed aids use ultra-sonic waves to guide the user by bouncing a sound signal off objects around the wearer of the device.

Most legally blind people can see, even if it is only to tell the difference between light and dark. Only about 10% of those who are legally blind cannot see at all. Simply put, people are legally blind, if, with the best possible corrective lenses, they can only see at a distance of six metres what is normally seen at distance of sixty metres, or if their field of vision is severely restricted. There are varying degrees of visual impairment, including tunnel vision, astigmatism, cataracts, colour blindness, double vision, and many others.

A sighted person often is suprised to discouver the wide array of activities, and the mobility and independence which the visually impaired person has. Just because you cannot imagine doing your job without your sight, it does not mean that it cannot be done.

1.3.8.1 Assisting the Visually Impaired

A blind person has some special needs, but they are not as extensive as you might think. If a blind person seems to need help, go ahead and offer assistance, but do not help unless the individual indicates that you may help. Always ask before you act. If you are not sure exactly what to do, ask the person to explain how you should help. Individuals have different needs at different times and blind people are not all the same. Offers of help are always appreciated, even when the answer is "no thanks, maybe next time." When approaching a blind person, use his or her name if you know it, or touch an arm so that it is clear to the individual that you want to make contact. Do not grab an arm unexpectedly. Identify yourself and put the blind person on equal footing. When you are ready to leave, tell the person that you are leaving -- anyone would feel foolish talking into thin air. Use a normal voice when speaking to a blind person, do not shout. Speak to the blind directly, never through a third party that might be with them; remember, their friends and companions do not read the blind person's mind, and no blind person is incapable in thinking for himself. A blind person hates to be talked down to, as does anyone else, so do not avoid using words like "blind," "look," "see;" since they are part of everyone's vocabulary. When giving a blind person directions, be as clear and specific as possible. Make sure to describe obstacles in the direction of travel, because some blind people have no visual memory, avoid using descriptions containing numbers of feet or yards. If you are unsure of how to direct a blind person, say something like "I'd be happy to give directions, how should I describe things?". To guide a blind person, let him or her take your arm. Do not grab the blind person's arm, as this is dangerous as well as insulting and frightening. The blind individual will walk about half a step behind you, following your body motions. If you encounter steps, curbs, or other obstacles, identify them. Try to verbally familiarize the blind person with his or her surroundings.

Lead the blind person directly to the chair, knees brushing the front of the seat. Selfseating should be allowed, or take the individual's hand when you reach the back of the chair and, placing the hand on the back of the chair, say, "this is the back of

the chair and there are (are not) arms at the side." Make sure that there are no obstructions around the chair. When seating is in a row, pause at the appropriate row, allow the blind person to take a position aligned along your side, and then begin moving into the row.

Approach stairways or curbs straight on. A pause in step and mention of the upcoming change are ways to inform the blind person of steps or a curb. To prevent stumbles, tell the person whether the steps are up or down. Pause at the last step to indicate the end of the stairs, or say that you have reached the last step. On Skytrain, all staircases are marked with tactile warning strips on the handrails and on the floor at the begining and end of stairways, also, there are tactile warning strips on the floor at intermediate landings.

When entering an elevator, enter together, release your grip, then turn inward and around with blind person to face the elevator door. The blind person will then grip your arm in preparation for exit. When approaching doors, signal the blind person to fall in behind, you should then state whether the door opens to the right or left, and whether it swings in or out. This enables the blind person to make adjustments so he or she can assist in holding the door open. If you must leave a blind person alone in an unfamiliar place, do it near something than can be touched so that he or she can maintain contact with the surrounding environment. It can be uncomfortable standing alone in an open space. When assisting a blind person to enter a car, guide the individual to the door and place his or her hand on the door handle. The blind person can then open the door, which, by it's swing, indicates the direction the car is facing. Before entering, the blind person may want to put a hand on top of the car to judge the height.

Dog guides must concentrate and be alert whenever in harness. Resist the temptation to pet a working dog guide. Whistling, feeding, and patting are big taboos, because the owner can be in danger if the dog is distracted from it's work. Always ask permission of the owner before approaching the dog. Remember, a blind person is more able to communicate with you than the dog is; therefore, address all your comments to the person.

1.3.9 Hearing Impairment

Hearing impairment is the "invisible" disability. At first glance there is nothing observably different about individuals with hearing disabilities. The most significant things about a hearing loss are that it can affect one's ability to understand speech and impede one's use of communications devices like the telephone. People who become deaf as an adult, through accident or illness, may react in the first instance, with depression or hostility. Their voice will probably sound normal since their loss of hearing came after they learned to speak. You will have no trouble understanding them, but they will probably have trouble understanding you.

The congenitally deaf, on the other hand, may be unable to modulate their voices. It has long been assumed, who have never heard speech, were unable to produce it. Today, through technology and intensive training, some congenitally deaf can learn to speak. Sign language continues to be the preferred mode of communication amongst the congenitally deaf. In sign language, gestures do the work of words. The movement of the hands and arms replace the spoken elements of language. Individual gestures are called "signs" are, like words, they are the basic units of the language. Symbols that represent actions and objects, feelings or concepts, much like nouns and verbs and adjectives in spoken language. Combined, individual signs form sentences

to express complete thoughts. Sign language is not simply English expressed with the hands rather than the voice, however, American Sign Language (ASL) which is used by most deaf Canadians, is a distinct language with its own grammar and syntax. It is a very compact and expressive language, which, like most languages can not always be directly translated into English. For many English words, especially jargon or technical language, no signs exist to express the precise meaning, so a "manual alphabet" is use to spell out words. This is called finger spelling. Literally it is "writing in the air." Because of the previlance of finger spelling cards, many people wrongly think that finger spelling is the same as sign language. It is only one component, though all forms of manual communication make use of finger spelling to a greater or lesser degree.

Unable to benefit from voice communication, deaf persons rely upon their eyes for signals. Whatever form of communication is used -- lip reading, sign language, finger spelling, or written language -- deaf citizens can express themselves and be understood by hearing people when both are willing to try.

People with normal abilities assume that those with a hearing impedement still hear all things but at a lower sound level. In fact, a phenomenon called "recruitment" can occur, it makes noises at certain frequencies sound much louder or are not understood by a hearing impaired person. Persons with "recruitment" are sensitive to low-decimal noises such as fans or engines and exposure to such noises is not only frustrating but painful. For these reasons deaf people may sometimes appear to "hear only what they want to hear." Some deaf people, especially those born deaf, still have problems with English, even in the written form. Such people will likely communicate in sign language.

While some signs are direct visual representations of an object or an action, many are not. It really is a distinct language. A fluent signer can communicate more rapidly than a hearing person using spoken language. Deaf people who are fluent in sign language may be less fluent in English, which in effect is a second language to them, a language learned at school by formal teaching. Like anyone else who has a second language, they might make grammatical errors in translating between the two.

1.3.9.1 Assisting the Hearing Impaired

When speaking to a hearing impared individual, face the person directly and provide a clear, well-illuminated view of your face, particularily your mouth. Speak clearly and distinctly in a normal tone of voice. Although you should not exagerate your lip movements, you should speak expressively none-the-less. You can use body language and or facial expressions to communicate things like sarcasm and seriousness that are usually indicated by tone of voice. A gesture will go a long way to aid understanding. If you are having trouble being understood, the hearing impaired person will ask you to speak up or slow down, or even to use a pen and paper. Shouting will not help. There could be many factors interfering with your communication process, aside from the inability of your passenger to read lips. Background noises could be a source of pain or frustration for someone using a hearing aid. Remember, communicating is your goal; the method does not matter. Relax, many deaf persons speak. Sometimes only the hearing person needs to write. When providing hearing impared persons with directions, be sure to supply visual aids, such as maps, to insure that they can see where they are going.

1.3.10 Mental Retardation

Mental Retardation covers a range of problems and causes, but, in simplest terms, persons who are mentally handicapped are slow or limited in their learning process and may not be able to readily apply what they are learning to their daily living. They can, however, develop at their own pace if encourged to do so. Although it is preferable to avoid labeling or strict catagorization of mentally handicapped persons, there are some widely accepted terms for differentiating between the various degrees of mental retardation: the educatable individual may achieve an academic competence of grade four or five, a moderate amount of social adjustment, and a satisfactory degree of self-support through jobs not requiring abstract thought. The trainable person may attain an acceptable level of self-care, social adjustment to home and neighborhood and a degree of economic usefullness in the home, residential facility or sheltered workshop. The totally dependent person requires assistance in personal care and usually requires permanent care outside the home.

The principle of normalization aims to make available to mentally handicapped persons patterns and conditions of everyday life that are as close as possible to the norms and patterns of society. There is widespread belief that mentally handicapped individuals do not reach the status of adulthood. New teaching methods have enabled the mentally handicapped persons to master the basic skills such as eating and dressing independently. Once these basic skills are mastered, the person's functional level can improve significantly, and the individual can proceed to more advanced tasks, resulting in less dependency on others.

1.3.10.1 Assisting the Mentally Handicapped

Offering assistance to the mentally handicapped is fine, but wait until your offer is accepted before doing anything. You may think someone needs your help, but the individual may prefer to do it alone, or may just be doing things at his or her own speed. Always ask first.

When communicating with the mentally handicapped person, keep your sentences short and simple, and your concepts clear and concise. Do not change the inflection or tone of your voice. The quality of your discussion depends on you making points clear and easy to understand. The mentally handicapped person understands concrete words because concrete thinking precedes abstract thinking in the developmental process. Sometimes a mentally handicapped person may seem to react to situations in an unconventional manner or may appear to be ignoring you. Remember that a lack of response or slow response does not necessarily mean that the person is being rude. A person with a mental handicap may simply respond slowly. Mentally handicapped passengers may be distracted easily, as they often have difficulty focussing on one aspect of sensory stimulation. You might find that a conversation is more productive in a quite location where stimulation is diminished. You might have to move your face closer to the person so that you have both the individual's visual and interest and auditory attention. It also might help to place your hand on the person's arm.

A PROGRAM TO PROVIDE INTERCITY BUS TRANSPORTATION FOR THE MOBILITY DISADVANTAGED

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In North America, according to statistics, 400 million pasengers travel by bus annually in regular service and over 200 million more in charter and tour services. With such a heavy volume of passengers, it is easy to overlook the relatively small number of mobility disadvantaged people who are unable to travel by bus.

In Newfoundland, Canada the only public intercity transportation service across the province is the Roadcruiser bus service operated by Canadian National. This service began in 1969, replacing a passenger train service.

The Roadcruiser service operates between St. John's, the capital city on the east coast, and Port aux Basques on the west coast of the province, a distance of 900 km. At Port aux Basques it connects with the CN Marine Ferry Service to North Sydney, Nova Scotia and at that point interconnects with mainland rail and bus services. Roadcruiser carried 240,000 passengers in 1985.

In 1979, following a review of services and facilities, work was begun to improve the accessibility of Roadcruiser terminals for disabled travellers. In 1981, the on-going practice of assisting passengers on and off the bus, including lifting where required, was made official Roadcruiser policy.

In 1982, in response to the report of an inquiry into the "Transportation of Disabled Travellers by Roadcruiser" conducted the previous year by the Canadian Transport Commission, an advisory committee was established. This committee is still in place and has representation from organizations representing the disabled community, as well as the Federal Government, the Newfoundland Government, the Canadian Transport Commission and Roadcruiser.

In 1983, Transport Canada provided funding for the acquisition of a wheelchair accessible bus to be operated by Roadcruiser in regular intercity service for three years as a demonstration project. No commercially available wheelchair lift was considered fully suitable for this new demonstration project. Most were lift platforms which, in operation, projected outside the bus, exposed to the elements; others were lifts incorporated into the front steps of the bus which were considered unsuitable for an intercity bus and unreliable given the severe service conditions likely to be encountered in Roadcruiser service.

In June 1984, T E S Limited, an Ottawa, Ontario based engineering firm, was contracted by Transport Canada to design, fabricate, install, and test

a wheelchair access device for an intercity bus. This device was to be a self-contained internal lift that would offer greater security and comfort to the user than an external lift.

In developing the lift concept, T E S Limited compiled and reviewed background information on all commercially produced lifts, as well as literature on research or development of wheelchair lifts and all applicable safety codes and standards.

As well as making lift users feel safe and secure, the parties to the project felt that the design features of the lift should minimize the number of bus seats and storage compartment space that would be lost. They also felt it important to retain the original interior and exterior appearance of the bus as much as possible to make lift users feel totally integrated with other passengers.

The lift is located on the right side (curbside) of the bus in the area of the middle baggage compartment, and consists of an upper and lower platform. The upper platform, which acts as the actual lift surface, replaces the main floor between the aisle and the right hand wall. The lower platform replaces the baggage floor below the upper platform and is suspended from the upper platform. This structure allows for minimal baggage compartment loss.

Operation of the lift is controlled by a microcomputer which receives commands from a driver operated hand-held control unit. The various steps necessary to operate the lift can only be carried out in the proper sequence, and after the status of various microswitches in the system is verified. The hand control unit has a display which informs the operator of any out of sequence condition which might occur.

Access to the lift platform at ground level is provided by a two-part folding ramp attached to the curb side of the platform. The size and slope of the ramp was tested and the design verified by wheelchair occupants using a mock-up of the ramp.

A standard MC-9 intercity bus, similar to the rest of the units in the Roadcruiser fleet, was ordered from Motor Coach Industries of Winnipeg, Manitoba by Transport Canada. The bus was delivered to T E S Limited in Ottawa in June 1984. The elevator lift was constructued and installed, and the completed lift-equipped bus was delivered to Roadcruiser in St. John's in December 1984.

A training program for employees was developed with the assistance of Transport Canada to instruct drivers and terminal personnel in ways of recognizing the special needs of disabled travellers and assisting them in using Roadcruiser service. The drivers and terminal employees were scheduled through this one-day training course in June 1984. When the bus was delivered to Newfoundland in December 1984, drivers and maintenance personnel were further instructed in the operation of the elevator lift.

FIGURE 1

MC9 Coach Equipped with Wheelchair Accessible Lift

Since it was intended that the bus should be fully integrated into the Roadcruiser fleet, setting the operating schedule for the accessible bus involved selecting the scheduled runs to which the accessible bus would be assigned and the days of the week on which it should operate. This was established according to the following criteria:

1. Use on a long-haul, i.e. St. John's - Port aux Basques cross-island scheduled run and a short-haul, i.e. St. John's - Grand Falls scheduled run if possible.

2. Schedules and times most heavily used.

3. Convenience for wheelchair passengers meeting or leaving the bus.

4. Availability of the bus at St. John's for servicing and repairs.

5. Optimum use of the bus during the three-year test period.

Two of the most heavily patronized runs in the current schedule are Run 517 out of St. John's at 12:30 p.m. on Fridays, arriving at Grand Falls at 7:30 p.m. and Run 520 out of Grand Falls at 12:30 p.m. on Sundays, arriving at St. John's at 7:15 p.m. This pair of runs met the criteria

for the short-haul operation in that they were heavily used by passengers and provided daylight operation over the whole route in summer and most of the route even in the winter months.

This initial scheduling decision established an arrival in St. John's on Sunday evenings at 7:15 p.m. St. John's is the headquarters for the Roadcruiser operations and repairs. It was felt that the bus should be held in St. John's on Mondays for inspection, servicing and performance of any necessary adjustments or repairs prior to operation on the long-haul service cross-island between St. John's and Port aux Basques.

This decision to hold the bus at St. John's on Monday limited the departure dates on the cross-island schedule to either Tuesday or Wednesday. A Tuesday departure to Port aux Basques would mean an arrival in St. John's on the return leg of the trip on Wednesday evenings at 10:30 p.m. This had the advantage of the bus being available for servicing and repairs on Thursdays prior to the scheduled Friday departure for Grand Falls.

The final scheduling was established as:

Tuesday's	Leave St. John's 8:00 a.m.; Arrive Port aux Basques 10:55 p.m.
Wednesday's	Leave Port aux Basques 8:00 a.m; Arrive St. John's 10:30 p.m.
Friday's	Leave St. John's 12:30 p.m.; Arrive Grand Falls 7:30 p.m.
Sunday's	Leave Grand Falls 12:30 p.m.; Arrive St. John's 7:15 p.m.

This schedule provided two days each week, Monday and Thursday, for servicing and necessary repairs to the bus. It also meant that the bus would operate about 90,000 miles annually, which was felt to be suitable over the three year experimental period. It had been decided that the lift would be cycled at least twice a week, that is, at each servicing in St. John's, as part of a preventative maintenance program to minimize possible road failures.

The fully accessible intercity bus was integrated into TerraTransport's Roadcruiser service on February 1, 1985. A toll-free telephone service was provided so that travellers requiring use of the lift could make advance reservations for wheelchair space, although this was not made a condition of travel.

The accessible roadcruiser bus is monitored and evaluated on a continuing basis by a Management Committee, chaired by a Transport Canada representative and having representation from the Canadian Transport Commission, the Newfoundland Government, Roadcruiser Services, and the Advisory Committee on the Transportation of Disabled Travellers by Roadcruiser. A progress report is issued every six months. A questionnaire was designed to provide consumer reaction and feedback on the operation of the service. The questionnaire results and statistical data relating to the operation of the accessible bus are analysed and used for evaluation. Operational statistics include the number of runs, ridership and use of the lift, reasons for travel, number of reservations for use of the lift, impact on regular scheduled service, passenger reaction, and impact on maintenance schedules and costs.

During the first year and a half of operation, reaction to the project has been very favorable. Respondents to the questionnaire felt the bus was easily accessible and that they were comfortable with the lift's operation. The thorough training provided to staff, in conjunction with the features of the lift, made the travellers being assisted feel secure. The survey has shown that most users of the accessible intercity bus travel have been for medical reasons. Newfoundland is a relatively sparsely settled province with most of the special care medical facilities located in St. John's, the provincial capital. Other reasons for using the special bus included transportation to school, employment and recreation.

Ridership by disabled travellers who use the lift to board the bus has been encouraging. The bus represents, for the disabled traveller, a "freedom to move" on an intercity basis. The pleasant design of the lift and tie-down areas of the bus make the wheelchair traveller feel fully integrated with other passengers on the bus. The accessible intercity bus has provided mobility disadvantaged travellers in Newfoundland with a transportation service which is economical, convenient and safe.

Travel in this accessible service by passengers in wheelchairs has averaged five passengers a month. Travel by disabled passengers, not in wheelchairs, appears to be no different for this bus than for the service as a whole and the general requirement for boarding and deboarding assistance, including lifting, has not changed. The lift has not yet been used for boarding disabled passengers other than in wheelchairs.

Following the experience with this bus, Transport Canada funded T E S Limited for the design and fabrication of a similar lift on an MCI model 102A3 motor coach. Inside the coach, two double passenger seats were designed to serve as individual restraints for two wheelchair users or as four standard passenger seats. Novel sliding/folding seats were incorporated in the seating plan to ensure "zero" passenger seat loss should no wheelchair users be travelling on the vehicle. This feature is of significant importance to intercity bus operators.

This modified motor coach has been named the "Accessobus" and on March 1, 1986 began a cross-country tour from Nova Scotia to British Columbia and currently operates as an intersite bus service and parking lot shuttle from May 1 to August 24, 1986, at Expo 86 in Vancouver, British Columbia.

Plans for the Accessobus after it leaves the Expo site at the end of August include a tour of Canada for the remainder of 1986. For the next two and a half years, the bus will be put into service for short periods of time with different bus operators across Canada. The objective of Transport Canada is to have an accessible bus in every major route in Canada within the next two years.

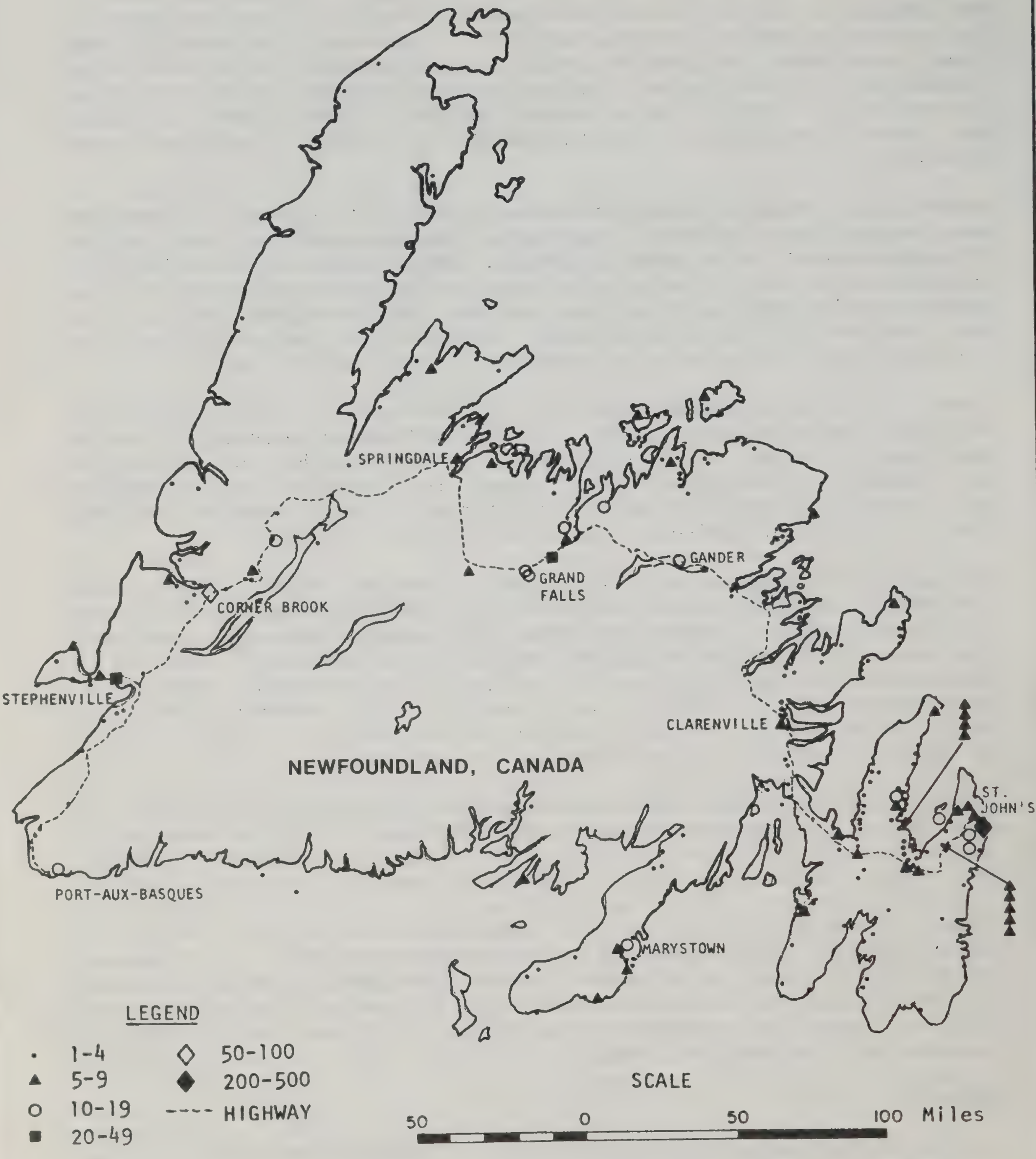
Appendix

1. Map of Newfoundland Showing Distribution Pattern of Non-Ambulatory and Severely Ambulatory-Impaired Persons.

2. Accessobus - Fully Accessible Intercity Bus/Autocar à accès universal.

APPENDIX 1

Distribution Pattern of Non-Ambulatory and Severely Ambulatory-Impaired Persons in Newfoundland



SOURCE - Children's Rehabilitation Centre, St. John's, Newfoundland. July 1981.

Accessobus

Fully Accessible Intercity Bus

Transport Canada | Transports Canada

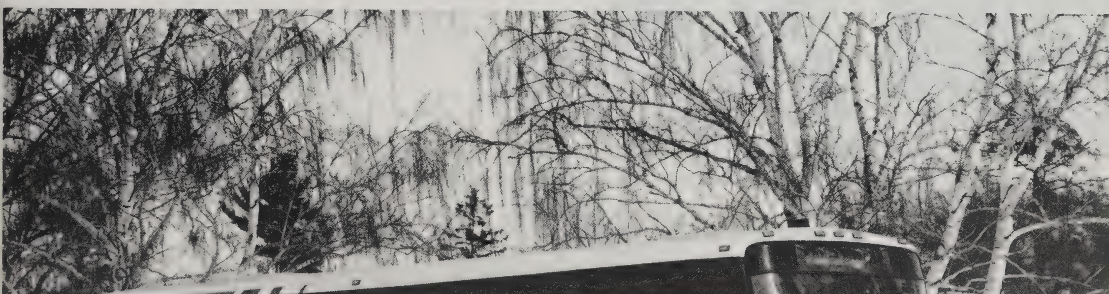
MCI TES

Transportation for the handicapped in Canada entered a new era in 1983 when the Human Rights Act was amended to provide accessible transportation services for mobility impaired travellers on a nondiscriminatory basis.

Traditional methods of boarding these travellers, wheelchair users in particular, in commercial vehicles are often neither safe nor dignified. Consequently, access to intercity bus service was restricted for many Canadians.

Transport Canada, in their objective to improve transportability of mobility impaired travellers, approached TES Limited to find a solution to this problem. The result is the Accessobus.

The Accessobus is a Motor Coach Industries model 102A3 motor coach, modified and equipped by TES Limited with a fully enclosed elevator lift. Inside the coach, two double passenger seats were redesigned to serve as individual restraints for wheelchair users or as four standard passenger seats. Revolutionary sliding/-folding seats were incorporated in the seating plan to ensure zero seat loss should no wheelchair users be travelling on the Accessobus.

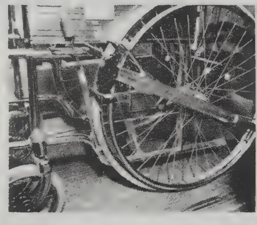


Accessobus Design Features

Internal Elevator Lift

The elevator lift is located on the curbside of the Accessobus in the area usually occupied by the middle baggage compartment. Structural analysis was carried out and then the main bus structure was modified to ensure that its performance remained the same as an unmodified bus and that all aspects of highway safety were met. The upper platform of the lift replaces the bus floor between the aisle and the right hand wall. The lower platform replaces the baggage compartment floor. Lift operation is controlled by a microcomputer which receives commands from the operator via a hand-held control unit. A hydraulic cylinder lowers and raises the platform. Users access the lift at ground level using a retractable ramp. The lift is totally enclosed by two air actuated doors. The doors are opened and closed by a keyswitch located on the exterior wall of the Accessobus. The lift and doors have manual back-up systems to allow boarding and de-boarding of passengers in the event of a system malfunction.

Wheelchair Restraints



The two wheelchair restraint positions feature special wheelchair tie-downs designed by TES Limited. The tie-downs have adjustable "claws" which wrap around the wheels and firmly secure the wheelchair in position. Each tie-down is designed to meet all applicable Canadian motor vehicle safety standards. The length of the tie-down arms is designed to accommodate wheelchairs with different rear wheel diameters, as well as most electric wheelchair models. They can also be adjusted laterally to accommodate different widths of wheelchairs. When not in use, the tie-downs can be secured conveniently out of sight.

Zero Seat Loss

The two wheelchair seating positions occupy the space of eight passenger positions. One wheelchair position is on the elevator lift, in its raised position, while the other is directly across the aisle from the lift. When no wheelchair users are travelling on the Accessobus, the displaced passenger positions become available through a uniquely designed collapsible seat system. The right hand restraint is converted to a two passenger seat by fastening a portable seat cushion in place. The left hand restraint is converted to a two passenger seat by simply unfolding a seat cushion secured against the back of the restraint. The regular seats in front of each restraint position are designed with fold up seat cushions and slide forward. All of these seats are designed to provide similar seating quality to the conventional coach seats. They allow seating of eight passengers and result in a "zero" passenger seat loss when there are no wheelchair users on the Accessobus.

Accessobus Lift Electronics

The wheelchair lift is controlled by a microprocessor system which communicates lift status to the operator. The lift controller monitors and controls the lift whenever the bus is running and allows the lift to be moved only when an operator is present at the lift. All operator commands are screened by the lift controller. Should any of the safety or operational interlocks be out of position, the lift will not move and the hand control unit will display a message explaining the problem to the operator. There are many safety interlocks incorporated into the design of the lift to ensure safe operation of the lift system. If any component of the lift system should malfunction, the controller provides a fully operational back-up mode to allow passengers to disembark or board without inconvenience.

Accessobus Contacts

Transport Canada
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Accessobus

Autocar à accès universel

Lorsque la Loi sur les droits de la personne a été modifiée en 1983 pour assurer aux handicapés moteurs l'égalité d'accès aux services de transport, ce fut le début d'une nouvelle ère des transports pour handicapés moteurs au Canada.

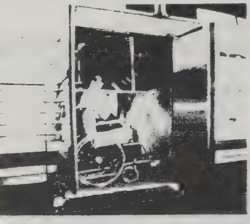
Les méthodes classiques d'accès aux véhicules commerciaux pour ces voyageurs, et en particulier pour les personnes en fauteuil roulant, n'étaient ni sécuritaires, ni très dignes, de sorte que bien des Canadiens n'avaient pas accès au service d'autocar interurbain.

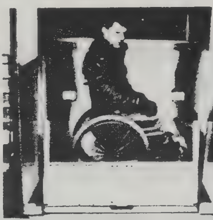
Transports Canada, dont l'un des objectifs est d'améliorer les transports pour les handicapés moteurs, s'est adressé à TES Limited, à la recherche d'une solution. Le résultat, c'est l'Accessobus.

L'Accessobus est un autocar de modèle 102A3 de la Motor Coach Industries, spécialement modifié et équipé par TES Limited d'un élévateur à enceinte. Deux sièges doubles ont été adaptés pour servir de support aux fauteuils roulants tout en conservant leur utilité comme sièges pour quatre passagers. Des fauteuils coulissants et pliants de conception révolutionnaire ont été installés dans l'autocar de sorte qu'il n'y ait aucune perte d'espace lorsqu'il n'y a pas de fauteuils roulants à bord.

Transport Canada Transports Canada

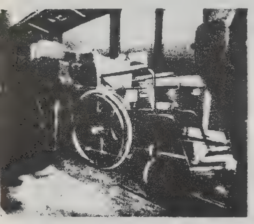
Élévateur interne

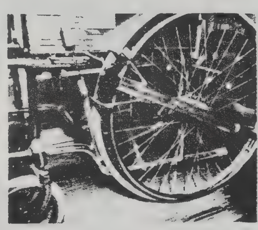




L'élévateur de l'Accessobus est situé du côté du trottoir dans la partie qui sert normalement de soute à bagages centrale. Par suite d'une analyse de la structure du véhicule, celle-ci a été modifiée de sorte qu'elle offre le même rendement que celle d'un autocar non modifié et qu'elle réponde à toutes les exigences de la sécurité routière. La plate-forme supérieure de l'élévateur est substituée au plancher de l'autocar entre l'allée et la paroi droite, alors que la plate-forme inférieure remplace le fond de la soute à bagages. L'élévateur est commandé par un micro-ordinateur, lui-même asservi à une commande que l'opérateur tient à la main. La plate-forme est mue par un cylindre hydraulique. Le passager monte sur la plate-forme au niveau du sol grâce à une rampe rétractable. L'élévateur est entièrement isolé de l'extérieur par deux portes actionnées à l'air comprimé, commandées par une clef située sur la paroi extérieure de l'Accessobus. L'élévateur et les portes sont dotés de commandes d'urgence manuelles afin qu'il soit possible de faire monter ou descendre les passagers en cas de panne du système.

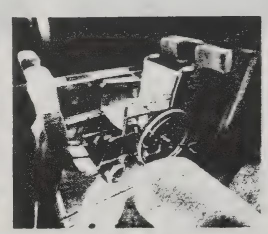
Supports pour fauteuils roulants





Les deux supports pour fauteuils roulants sont dotés d'attaches spéciales conçues par TES Limited, munies de griffes réglables qui saisissent les roues et arriment le fauteuil. Chaque attache répond à toutes les normes canadiennes de sécurité automobile. La longueur des bras d'arrimage est conçue pour que les supports reçoivent des fauteuils à roues de diamètres différents, ainsi que la plupart des fauteuils électriques. Il y a également un réglage latéral pour adapter le support à différentes largeurs de fauteuil. Lorsqu'elles ne sont pas en usage, les attaches sont entièrement escamotées.

Aucune perte de capacité



Les deux postes réservés aux fauteuils roulants occupent l'espace de huit sièges pour passagers. Le premier poste est sur l'élévateur levé, alors que le deuxième est de l'autre côté de l'allée. Lorsqu'il n'y a pas de fauteuils roulants à bord, un système de sièges pliants permet d'exploiter l'espace qui leur est réservé. Le support de droite se transforme en un siège pour deux passagers par l'ajout d'un coussin démontable. On transforme celui de gauche de la même manière, en rabattant un coussin. Les sièges ordinaires qui sont en avant de chaque poste ont des coussins relevables et glissent vers l'avant. Tous ces sièges sont aussi confortables que les sièges d'autocar ordinaires. Ils permettent à huit passagers de prendre place dans l'espace réservé aux fauteuils roulants, de sorte qu'il n'y ait aucune perte d'espace pour passagers lorsqu'il n'y a pas d'handicapés à bord de l'Accessobus.

Commandes électroniques de l'élévateur

L'élévateur pour fauteuils roulants est commandé par un microprocesseur qui informe l'opérateur de l'état de l'appareil. Un contrôleur commande et contrôle l'élévateur lorsque l'autocar est en marche et ne permet d'actionner l'élévateur que si l'opérateur est sur place. Toutes les commandes sont filtrées par le contrôleur. Si les clenches de sécurité ou autres ne sont pas en place, l'élévateur ne bougera pas et la commande affichera un message à cet effet à l'intention de l'opérateur. Plusieurs clenches sécuritaires ont été incorporées à l'élévateur afin de garantir la sécurité. S'il y a défaillance d'un élément du système, le contrôleur assure une commande de rechange complète afin que les passagers puissent monter ou descendre sans inconvénient.

Contacts au sujet de l'Accessobus

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The Transfer Chair for Access to Motor Coaches Concept, Testing and Implications

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1. INTRODUCTION

There currently exists a trend towards increased travel by persons with mobility restrictions. As this market increases, the transportation industry is recognizing the need to develop devices which overcome barriers inherent in the transportation system. One such barrier - stairs leading onto intercity buses can create difficulties for many segments of the elderly and disabled population. For this reason, the "Kingston Transfer Chair" has been developed. This device, which is intended to enhance intercity travel, moves passengers with mobility restrictions up or down the stairwell of intercity buses. Potential benefits initially cited during development of the device were reduced risks taken by bus terminal employees by eliminating the need to carry non-ambulatory passengers into/out of buses, increased ridership for intercity bus travel and the elimination of bus modifications resulting from retrofits such as wheelchair lifts to make the vehicles accessible for the mobility impaired.

The Transportation Development Centre (TDC) of Transport Canada funded the production of five "Transfer Chair" devices designed by J.C. Kingston. These were to be demonstrated in the Quebec-Windsor Corridor.

2. THE KINGSTON TRANSFER CHAIR

The Kingston Transfer Chair is a relatively simple device which is positioned into the doorway of the bus to a position where the upper end of the boom is near the bus driver's seat (Figure 1). A disabled person may then be positioned into the chair and raised by means of an electrically driven feedscrew into the bus through the conventional doorway opening.

Its principal purpose is to eliminate the effort, the risks and the indignities suffered by both the disabled and bus terminal employees when physically lifting such travellers into and out of buses.

The complete transfer chair prototype weighs 74 kg. The inventor holds a Canadian and U.S. patent. The device has been developed for use in MC9 motor coaches, but design alterations to accommodate other types of buses such as Prévost's "Mirage" and Eagle's "Model 10" are also available. It can also be used on MC7 and MC8 with height adjustments to the boom head support leg. The mechanism is powered by direct connection to a 110 volt A.C. outlet. It could also be operated with a periodically charged battery or power pack assembly, or by connection to the 24 volt D.C. circuit in the motor coach.

The device is designed to operate on a smooth and leveled surface. The design payload is 135 kg.

The transfer chair is controlled via a control panel consisting of an on/off switch, a forward/brake/reverse switch and a variable speed control (rate of ascent or descent).

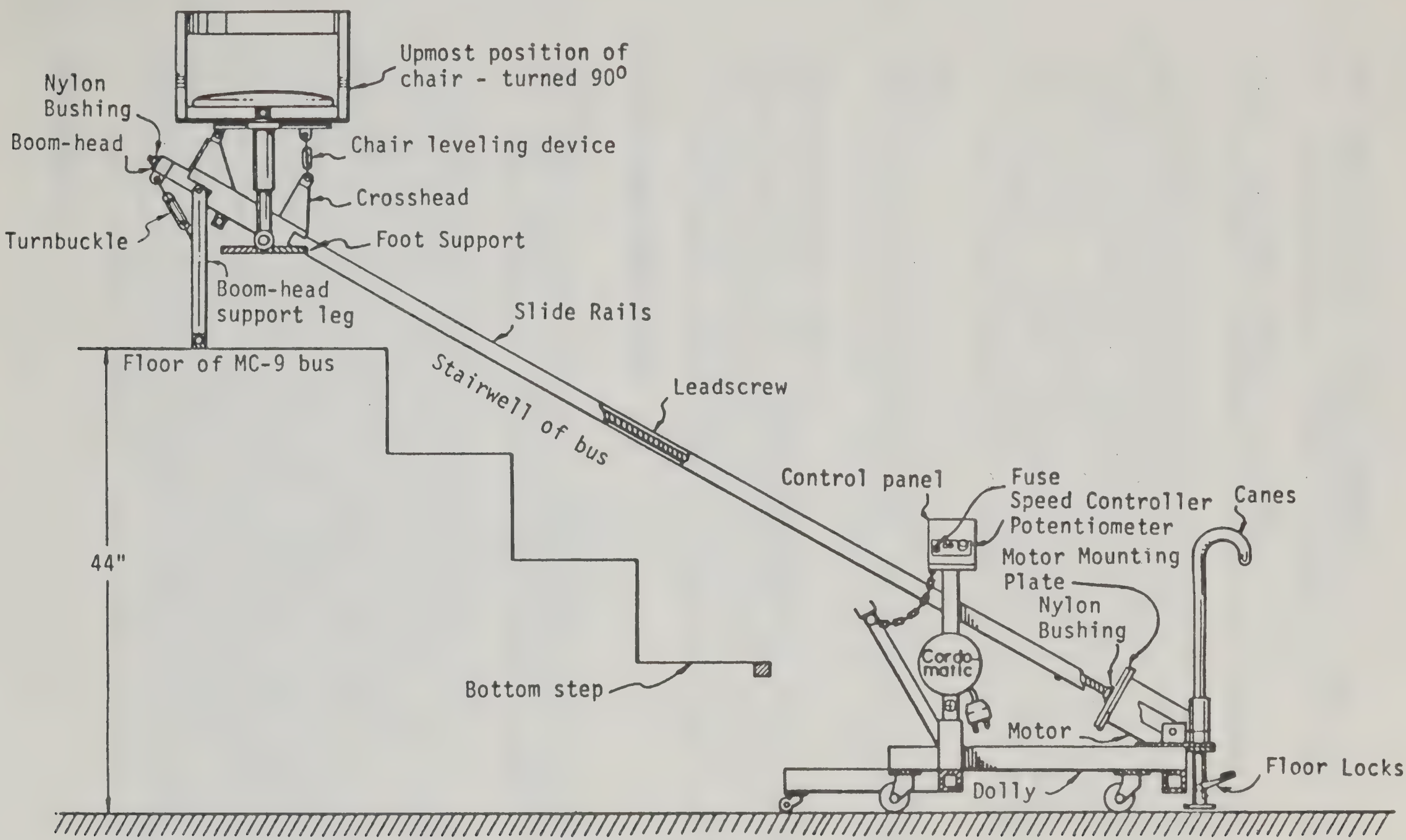

FIGURE 1

Transfer Chair Schematic

A disabled person can be brought up in the bus by sitting in the chair when it is at its lowest position on the boom, and can be held in the seat by the seat belt. Once the person's feet have been placed on the footrest, the operator activates the system and the chair is displaced toward the top of the stairs. After immobilizing the chair at the top, through a limit switch, the chair is manually turned to face towards the aisle of the bus and the disabled person is helped out of the chair into one of the front seats of the bus. The operation is reversed to bring the disabled person down to the bus terminal platform.

3. TESTING

Prior to the devices being put into service in the Quebec-Windsor Corridor, the transfer chairs were subjected to some preliminary tests, that were to take place before the demonstration phase.

The primary activities carried out in this phase were the mechanical testing, ergonomic testing and preparation of user surveys, preparation of publicity and other associated material required for the successful conduct of the demonstration project. The role of the mechanical testing and the ergonomic evaluation was to ensure that the proposed transfer chair met basic functional, structural and safety considerations. A test program was conducted to evaluate the stability, dynamics and operational principles during cyclic operation of the transfer chair.

The drive mechanism, slide mechanism, electrical controls and structural assembly were examined for overall workmanship and assembly integrity. The inspection showed that most nut-and-bolt assemblies were loose and required tightening to prevent fastened assemblies from separating during future operation of the device.

Several observations during the mechanical and ergonomic evaluations indicated that the transfer chair has some serious shortcomings in the area of safety.

A number of deficiencies were noted with regard to the control panel. Most significant among those was the lack of an automatic reset switch. The adjustment and securement method of the seat assembly was considered to be another area of concern. The levelling and rotating features compromised the ability to provide a secure ride.

The durability and performance of the device were evaluated by conducting a test program whereby the transfer chair was raised and lowered with it's rated load for 1000 cycles. The operation of each cycle was carried out in accordance with instructions found in the operator's manual.

During the cycling, the floor locks behaved adequately under all cases except on sandy surfaces, a condition which is not expected however, to be prevalent under normal operating conditions. During the cycling of the transfer chair, operational degradation was monitored closely. A number of critical components experienced deformation, including crack propagation during testing. Due to the torque applied and, to a lesser extent, to the vibrations experienced, the feedscrew suffered a slight bent. The slide rails experienced a slight deformation resulting in a reduction of the outside spacing of 1.5 cm. This difference provided room for side-to-side movement of the transfer chair. Weld cracking were observed in a number of areas. These structural degradations and deformations demonstrated the inability of the device to satisfactorily achieve its design objective with its rated design load.

The utilization of the device by potential users has been extensively evaluated and it became obvious that some basic requirements of the user and operator were not adequately considered in the design of the chair. The chair is relatively inaccessible as barriers exist on all sides. The canes do not offer a physical support eventhough they appear to be the only means of support. The seat height is 7.5 to 10 cm higher than the standard wheelchair.

In addition, the movement of the transfer chair has the potential of being a very cumbersome and possibly dangerous operation. The positioning of the device in the bus requires a high level of skill and effort. Any deviation from an acceptable position could result in a dangerous situation.

4. IMPLICATIONS OF THE FINDINGS

The mechanical and ergonomic testing of the Kingston Transfer Chair clearly illustrates that while the concept of a transfer device appears valid, the current transfer chair device has not performed sufficiently well to be tested by the general public.

While the concept of evaluating the transfer chair device within an in-service environment is a desirable one, such an approach using the existing Kingston Transfer Chair would compromise the safety of the potential users of the device and would, because of mechanical and functional shortcomings, severely limit its use by bus operators.

Further development of the transfer chair concept is required to ensure that all aspects such as user and operator requirements, vehicle constraints and operating environment constraints are considered.

The development of the transfer chair concept into a fully operational device requires a logical, stepwise approach in which various refinements can be incorporated into the designs as the development proceeds.

5. FEASIBILITY STUDY

Eventhough the chairs produced are not suitable for public use in an operational service demonstration, it is worthwhile to conduct some further experiments with the available chairs to achieve the following objectives:

- o to identify the level of workability of a transfer device concept;
- o to provide criteria that will be used to assess other proposed station-based transfer devices.

The work will be undertaken as follows:

5.1 Modified Chair

As five transfer chairs are available for testing, one or more chairs will be modified for experimental purposes. The changes that will be incorporated will only be the ones that are considered essential for a realistic evaluation of the basic feasibility of the concept. It is possible that only the seat may need to be redesigned. It should be relatively straightforward to find satisfactory ways of positioning a boom, mounting passengers in the low position, and ensuring safety during the ride along the boom. The critical operation determining the feasibility of the transfer chair concept is almost certainly the transfer of passengers between chair and bus seat. The new work should concentrate on exploring solutions to the space and human factors limitations affecting this transfer.

5.2 Safety

It is essential that any area of concern regarding user or operator's safety be addressed. Modifications that are deemed esential for limited experimental testing will be made.

5.3 Testing

Controlled tests with handicapped pasengers representing various target groups will be undertaken. The results of this testing will be analyzed.

5.4 Workability of the Concept

The workability of the concept will be examined for various levels of modification to the bus such as no change, minor entrance changes, bus seat modification, partial or complete removal of the right-hand safety bar/vanity panel.

5.5 Design Criteria

Design criteria will be developed in order to provide the basis for a satisfactory transfer device concept, and also to be used in the review of other potential design concepts.

These criteria will include user related constraints, operator human factors constraints and vehicle imposed limitations. The objective is to find out whether or not this transfer device concept is feasible on technical and human factor grounds. This work will involve most current bus types, with different stair configurations, the MCI (MCI and MC9) and the Prévost (Mirage and Marathon).

6. CONCLUSION AND RECOMMENDATIONS

It is unfortunate that the Kingston Transfer Chair was unable to meet basic safety, functional and structural requirements since the study team feels the concept of a transfer chair device does offer potential to serve a certain segment of the mobility restricted traveller market. Consequently, further development of the transfer chair concept is required to ensure that all aspects such as user and operator requirements, vehicle constraints and operating environment constraints are considered.

The feasibility study will enable a better understanding of the operational requirements of a transfer device and will offer a possibility for evaluating new concepts.

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ADAPTATION OF VESSELS TO THE NEEDS OF DISABLED PERSONS - A HANDBOOK

Claes-Eric Norrbom
Director-General
The Swedish Board of Transport

ADAPTATION OF VESSELS TO THE NEEDS OF DISABLED PERSONS - A HANDBOOK

Author: Claes-Eric Norrbom, Swedish Board of Transport

The goal for the Swedish policy as regards disabled persons can be summarized in two words - normalization and integration. This implies that disabled persons to as large an extent as possible shall have the same situation of life as other people and that they shall be able to participate in the society.

The means of communication are of vital importance for the possibilities for disabled persons to participate in various activities in the society. Sweden's policy on mobility for disabled people has followed two main directions, one being the adaptation of the public transport system to the needs of disabled persons and the other the establishment of a special transport service. In addition there is the possibility of financial assistance to disabled people in need of a private car.

In consequence with the Swedish policy as regards disabled persons the basic view is that mobility impaired persons have a right to and need of transportation to the same extent as other groups. Making the public transport system accessible to and useable by all categories of people was therefore a natural part of the transport policy goal of ensuring a satisfactory transportation service for all citizens.

As part of the 1979 transport policy resolution - the Parliament took a decision that implies:

- a gradual adaptation of the public transport vehicles, terminals and immediate environment

- an increased financial support for research and development

- the establishment of an experimental national transport service.

With respect to the rate and extent of the suggested measures, a period of ten years was deemed feasible. The adaptation of public transport vehicles was laid down in a special Act (1979:558) in force since January 1, 1980. According to this Act all regular transport vehicles that run according to a timeable shall be adapted to the needs of disabled persons, whether by land, sea or air. The Swedish Board of Transport, which was set up at about the same time, has been given a co-ordinative responsibility which includes planning, initiating and following up the adaptation. The co-ordinative role is expressed in the issuing of directions that are binding on transport enterprises and supervisory authorities.

One of the prerequisites for a consistent adaptation of public transport vehicles is thorough knowledge, both on the actual needs of the disabled and on how the adaptation can be accomplished. Consequently the transport policy resolution implied

an increased financial support for research and development. In 1979 the Transport Reasearch Delegation (TFD) initiated a research program for the development of public transportation design for the elderly and handicapped. Within this research program an inventory of development work in the different transport sectors were made and particular research efforts were suggested.

In 1981 TFD made an estimate that the number of persons in Sweden with an ambulatory handicap is about 1 million people. The number of people was broken down by various kinds of disabilities. The below figures relate to persons 16-74 years of age and the groups are partly overlapping as one person can suffer from more than one kind of impairment.

Persons with walking difficulties	400.000
Persons in wheelchair	30.000
Persons with vision impairment	70.000
Persons with hearing impairment	400.000
Persons with allergy problems	150.000
	1 million persons

Source: TFD publication 1981:6 based on Report No 25 on Living conditions from the National Central Bureau of Statistics.

The total population of Sweden amounts to about 8,3 million people. This means that about 12 % or every eight person in Sweden has some kind of disability that more or less impede his or her possibilities to travel by public transport means.

Out of the longdistance travels in Sweden approximately 50 % are made by train, 33 % by bus, 10 % by air and 5 % by sea. Although only a small percentage of all public travels are carried out by sea it is important that the vessels can be used by everybody as it can be very hard to find alternative modes of transportation in the archipelago surrounding the Swedish mainland and to the island of Gotland.

There has been only a few studies made, which aimed at clarifying the situation of disabled persons in connection with sea travels. The ferry traffic to other countries and to the island of Gotland has recently developed very rapidly. The ships used in this traffic are usually big and very modern and has a general standard that make them useable also by persons with mobility impairments. There are often lifts onboard and the newest ships have special toilet and cabin facilities for disabled persons.

The terminal buildings are mostly quite new and are well adapted to the needs of disabled people.

The use of transport vehicles and design of terminals is closely linked, since an inaccessible terminal obstructs the use of an adapted vehicle and vice versa.

Consequently, as the new Act on adaptation of the vehicles came into force, the building by laws were changed so that all terminal buildings shall be made accessible to disabled people within a period of ten years.

In the archipelago of Stockholm and Gothenburg the vessels are mostly used for connecting the many islands with the mainland and for this service vessels of a smaller kind are used. These vessels are mostly comparatively old and for the disabled these boats are rather inaccessible - no lifts, narrow doors and small toilets etc. As the regular traffic in the archipelago increases it can be expected that new boats will be needed. The possibility of making the new boats more accessible improve, especially if the constructors and manufactures are aware of the needs of disabled persons.

Some experience and knowledge from research projects were available but the information was scattered. In order to put this information together the Transport Research Delegation gave priority to a project aiming at producing a handbook (guide) for constructors and manufacturers of vessels. The handbook should provide a tangible and complete basis for fulfilling the law as regards adaptation to the needs of disabled persons within the sea transport area.

A special committee was set up for guidance of the project and the assembling of facts was carried out by a researcher from the Institute of Technology in Luleå. The work was started by analysing the problems encountering different groups of disabled persons onboard. This analysis was of great value to the Swedish Board of Transport when formulating the directions for adaptation of vessels to the needs of disabled persons. The directions are divided into various articles following a logical sequence, for example

- information on destination
- entering the vessel (embarking and disembarking, doors and doorways, steps)
- inside the vessel (space for wheelchair, seats, handles and supports, toilet)
- information onboard
- flooring
- illumination
- measures for allergic persons.

These directions apply to all passenger vessels in Swedish inland traffic, which are equipped for 100 or more passengers and whose keels have been laid after the end of 1959. The directions issued by the Swedish Board of Transport can be said to be functional directions and do not provide information on the adaptation as regards construction, equipment and operation. Such directions shall be issued by the National Admini-

stration of Shipping and Navigation, which therefore participated actively in the project of producing a handbook.

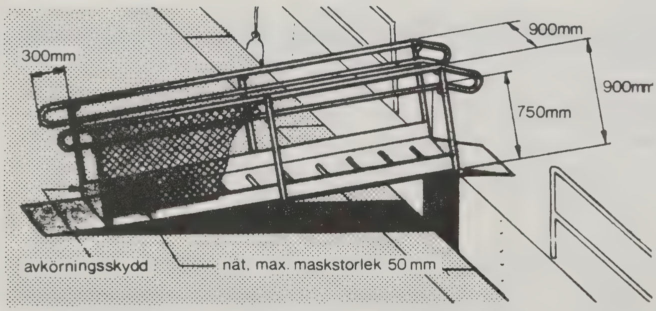
The handbook is primarily directed towards purchasers, designers and manufacturers of smaller passenger vessels. The aim is to specify what the directions mean in practice so that the handbook can serve as a book of reference and ideas. The suggestions are primarily applicable for vessels under construction but many of the ideas can also be used when reconstructing existing tonnage.

Embarking/disembarking

The directions state "Vessels shall be designed and equipped so as to allow wheelchair-borne and other physically disabled passengers to embark and disembark the vessel either manually or with the aid of a lifting device, an adjustable bow or ramp or similar arrangement".

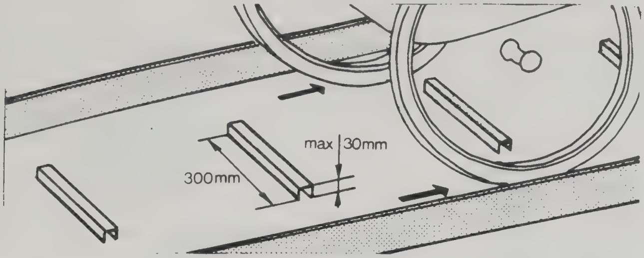
Difference in level between quay and deck often implies steep gangways, which make embarking and disembarking difficult for many persons. In the handbook examples are given of various kinds of technical aids to overcome these problems. For traditional gangways there are some general demands:

- o The maximum incline of gangways which a person in wheelchair can manage is about 1:20 (3 degrees). With assistance an incline of between 1:4 (14 degrees) and 1:3 (18 degrees) can be managed. The length of the gangway should then not exceed 2 metres.
- o The gangway shall have a minimum free width of 900 mm between handrails.
- o The handrails shall be placed at a height of 900 mm for walking passengers and at a height of 750 mm for a person in wheelchair. The handrails shall extend 300 mm over the two ends of the gangway.

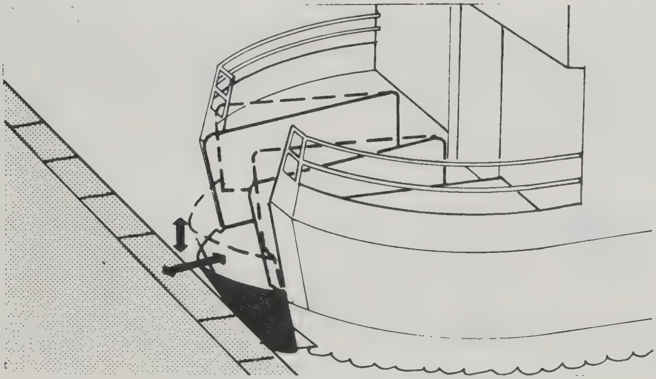


- o The gangway shall be equipped with a protection net (mesh size not exceeding 50 mm) or canvas.

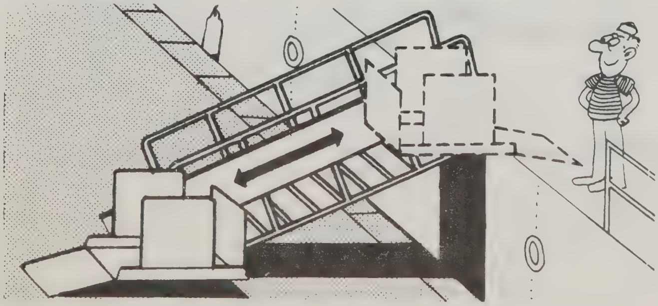
o The grid should not exceed 10 mm width and 20-30 mm length so that guide dogs, sticks or high heels do not get caught. Another alternative is to use antiskid strips with a length of about 300 mm and a height of maximum 30 mm permitting a wheelchair to pass with its wheels outside the strips.



A non-fixed gangway shall be moved manually and must therefore be light and easy to carry. Consequently the gangway must be relatively short and can therefore only be used when the difference in height between deck and quay is relatively small. Another alternative can be a mechanic gangway or a lifting device onboard as shown below



Lifts of different kinds are of value for the passengers when there are big differences in level between deck and quay. However, the lifting device can easily be damaged when calling at quays.



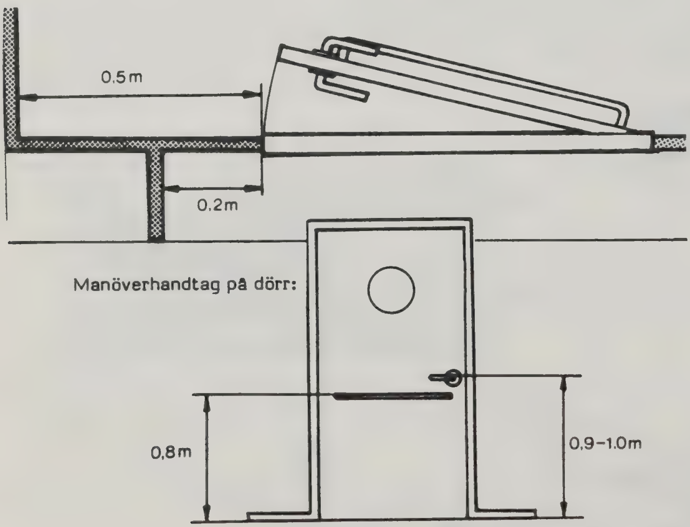
Another possibility is a lifting table if it shall be mounted onboard, the deck must be below quay level.

Doors and doorways

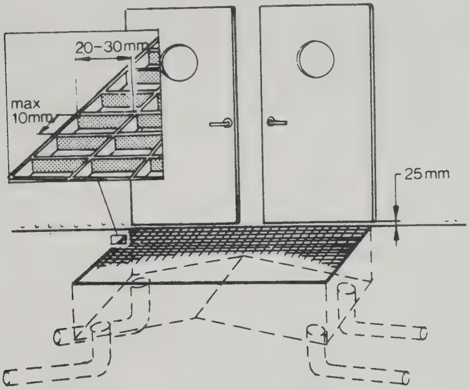
"Doorways to passenger accomodation shall be wide enough for a wheelchair to pass through without difficulty. Doors shall be possible to block in an open position".

In general a door shall open from a frequently used room into a less frequently used area. However, this does not apply to toilet doors, which should always open outwards.

The door opening shall be at least 850-900 mm to allow a wheelchair-borne passenger to pass. In order to allow him to reach and open a door the free space shall be 0,5 m at the opening side of the door and 0,2 m at the other side. Sliding doors are a good alternative to traditional doors.



Thresholds shall be avoided as much as possible. If there is a threshold it must not exceed 25 mm height and where higher thresholds are necessary a ramp or a collapsible or removable sill should be used. A high threshold to the outside deck can be replaced by a lower one if it is combined with a drain well.



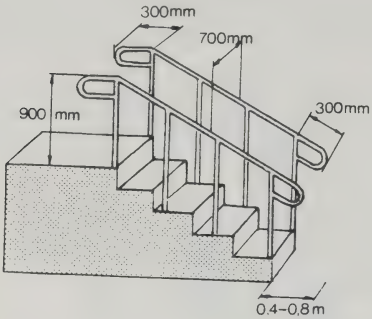
Thresholds and ramps shall be contrastingly marked.

Steps

"Steps treads and risers shall be carried out in such a way, or be equipped with such devices, as to facilitate the mobility of disabled persons and provide safety with regard to i.a. height, depth, foothold, illumination and colouring. The edges of step treads and the floor directly above and below the stairs shall be marked in contrasting colour".

The handbook provides further information stating that the width of the tread should preferably be about 300 mm, not less than 250 mm, and the height of the risers shall preferably be 150-180 mm, not more than 200 mm. The incline of the flight of steps should not exceed 38 % and there shall be not projecting noses or open steps. The free height for passing under a flight of steps should be at least 2.20 m, minimum 2 metres.

There shall be handrails om both sides of the stairs and these shall extend not less than 300 mm beyond the top and bottom step in the stairs. The distance between the handrails shall be minimum 700 mm and maximum 900 mm.



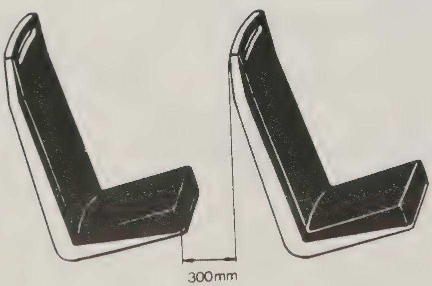
Single steps in passages or similar areas shall be avoided, specially in connection with doors. A flight of stairs should not be placed athwartships as this could make evacuation more difficult in case the vessel should have a heavy lopsidedness.

Seats and space for wheelchair

There shall be at least one special place for a wheel-chair per 100 passengers so that a wheelchair-borne passenger can travel by the vessel sitting in his wheelchair during the trip. It shall be possible to secure the wheelchair in a way that ensures safety. It should also be remembered to provide for wheelchairs at the tables in the restaurant.

At least 4 % of the seats, but not less than 4 seats, shall be marked and primarily intended for disabled passengers. The seats shall be designed for physically disabled persons so that sufficient space and suitably designed and positioned handles are available to facilitate the act of sitting down, maintaining comfort while seated and the act of standing up.

For allowing a person to stand upright between two rows of seats there shall be a distance of 300 mm, measured from the front part of a seat to the vertical line of the seat ahead. The backrest shall not have a special support for sway-back and the seat should not be cupular. However, a slight curving of the backrest is an advantage from a stabilizing point of view.



Toilet

"At least one toilet room shall be adapted to disabled passengers and be dimensioned for a person in wheelchair. All toilet rooms shall be furnished with support handles contrastingly marked in their full length".

The door to the toilet room should always open outwards. The toilet bowl should be accessible from both sides and the height should be about 48 cm above the floor. The toilet paper holder should be placed at a height of about 800 mm above the floor and should not be more than 400 mm away.

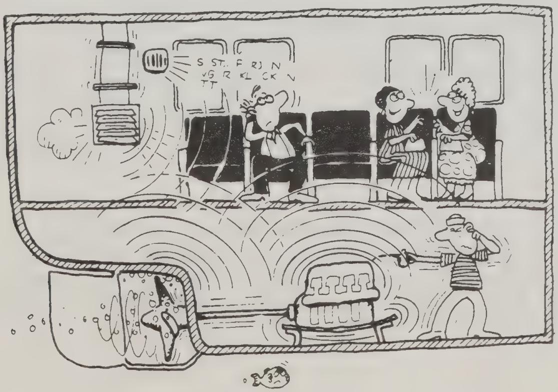
The wash-basin, which should be placed at a height of 800-850 mm, should preferably be of rectangular shape with a size of 560 x 420 mm. The front edge should be wide enough to provide support for the forearms. There shall be a knee-free space with a depth of 600 mm below the washbasin and a free width of 700 mm so that a person in wheelchair can come close enough. If there is a mirror it should be placed directly above the washbasin at a height of about 900 mm.

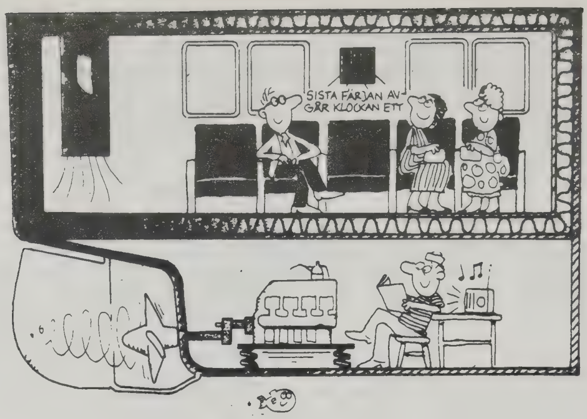
The toilet room should be provided with an alarm system and should if possible have a window that can be opened.

Information onboard

Vessels shall be equipped with such technical means as to make it possible to announce each pier served according to timetable in such a way that visually impaired persons´need for audible information can be met. Hearing impaired persons´ need for information shall also be appropriately met e.g. by route maps or display devices.

Loadspeakers should be dimensioned and placed so that the information can be clearly distinguished from background noise, from engines, propeller, ventilation system etc. Induction loops should be installed in chosen areas. Absorbing materials that are non-allergenic should be used to compensate for echo effects.





Sign shall be placed on the wall at the same side as the door handle.

For visual reading the sign should be placed at a height of 1,4 - 1,6 m above the floor. The use of symbols together with text is advisable. Lowercase letters are the easiest to read. All words should beevenly spaced. There should be great difference in contrast between the text and the background colour of the sign. Negative text, i.e. white letters on black bottom, is easily read. Other good combinations are yellow on black, white on green, or white on red. When choosing the colour of the sign, the colouring of the surroundings must be considered. Signs shall have a half matt surface to avoid dazzling effects and should not be covered by glass. It may be necessary to have special illumination which could be placed above, inside or behind the sign.

For tactile reading the sign should be placed at a height of 1,3 - 1,4 m above the floor and the letters should be 15-40 mm high. The raised relief should be about 0,5-1 mm. It is advantageous if signs provide for both visual and tactile reading at the same time.

Measures for allergic persons

The furnishings in the vessel shall as far as possible be made from non-allergic materials. Many persons can be sensible to dust, chromium, nickel, exotic sorts of wood, certain kinds of glue etc.

In passenger accomodation there shall be a non-smoking area.

Passengers who are accompanied by furred animals shall be directed to a special seat by means of a notice or in some other manner.

Conclusion

To obtain the goals of integration and normalization, it is essential that the needs of disabled persons are considered as early as possible - preferably already at the idea and design stage. With an appropriate basic design many problems can be avoided and the costs can held at a minimum compared to the costs for adaptation afterwards. The points discussed bring about a better ship from the point of view of seaworthiness and work environment at the same time as comfort and accessibility increase for all passengers onboard.

FOURTH INTERNATIONAL CONFERENCE ON MOBILITY AND TRANSPORT FOR ELDERLY AND DISABLED PERSONS

Madeleine Delaney-LeBlanc
Director Public Affairs
100 Cameron Street
Moncton, New Brunswick
Canada E1C 5Y6

It gives me great pleasure to be here with you today as a participant in the Fourth International Conference on Mobility and Transport for Elderly and Disabled Persons. I am pleased also with the opportunity to visit Expo '86.

For those of us involved in the transportation field, it is apt that Expo '86 is focussed on transportation, because we are truly living in a global world. It's a world shared increasingly, on an equal footing, with our disabled brothers and sisters. In the past twenty years, the disabled in Canada have made great advances, largely because of their own efforts in pushing governments and corporations like my own to respond to their needs and desires to be full citizens in this country.

I'm particularly proud to be here today as a representative of CN Marine/Marine Atlantic, because I believe that our corporation has made an exemplary attempt in the past half dozen years to make its services accessible to the disabled. I must say that we couldn't have done it without the advice and assistance of the disabled themselves.

I want to talk to you about some of the changes that we've made. But first, let me tell you something about CN Marine itself. CN Marine is Canada's youngest Crown corporation. CN Marine was given the status of Crown corporation effective January 1, 1985, and has since operated independently from CN, the national railway company. The Parliament of Canada passed, very recently, a bill of law establishing <u>in fact</u> the new Crown corporation under the new name of Marine Atlantic.

At the time of writing these remarks the Bill is somewhere between third reading and Senate approval and I don't know whether Royal Assent will have been given by the time I make the presentation, so I will keep referring to CN Marine/Marine Atlantic.

Under various names and through a variety of agreements with the Government of Canada, CN has provided ferry services in the Maritimes since 1919. Those of you who live here in British Columbia will understand the important role that a ferry service plays in a coastal region like Atlantic Canada. It's been said before, but it bears repeating, that a ferry service picks up where the roads leave off. For those living on Prince Edward Island, Newfoundland and Labrador, and even in parts of New Brunswick and Nova Scotia, travelling by boat is often "the only way to go". Ferry travel isn't a luxury. It's a necessary requirement of daily life by the sea.

As the provider of that necessary service, CN Marine/Marine Atlantic has eleven terminals along a coastline that stretches from Goose Bay, Labrador to Bar Harbor, Maine. In 1985, the 17 vessels in our fleet carried more than 2.3 million passengers and nearly one million vehicles as well as thousands of rail cars, containers, and tons of freight.

Our service between New Brunswick and Prince Edward Island is the most heavily used, with four ferries carrying over 1.6 million passengers and 590,000 automobiles between the two provinces in 1985. We also have two ferry routes which cross the Bay of Fundy, providing excellent alternatives to a long highway drive.

CN Marine/Marine Atlantic operates an essential service between Newfoundland and Nova Scotia. We are now in the process of modernizing our fleet on this service. Six older vessels will be replaced with three large, modern ships. The first of these, MV Caribou, has just been completed. As the largest ferry ever built in Canada and one of the largest in the world, she can carry up to 1,200 passengers on each crossing between Port Aux Basques, Newfoundland and North Sydney, Nova Scotia. The Caribou boasts state-of-the-art technology including a precise navigation system to facilitate docking in confined harbours in adverse weather conditions. In order to accommodate the Caribou, bi-level loading facilities were constructed in both North Sydney and Port Aux Basques, and a new passenger services building was completed in North Sydney.

We have also chartered a second vessel, a large roll-on, roll-off freighter, which sails between Port Aux Basques and North Sydney. We are now investigating the possibility of permanent acquisition of such a ship for the Gulf service. A third ship, to complete the modernization of the Gulf fleet, is expected to be built by 1990.

We believe this modernization process demonstrates CN Marine/Marine Atlantic's on-going commitment to efficiency of passenger service. We have a responsibility, indeed a duty, to respond to the needs of travellers, not just to see that ferry crossings are at convenient times, and that the ship doesn't sink on the way over, but to see that **all** passengers are treated with dignity and consideration.

Over the years, CN Marine had made some effort to make its facilities more accessible to the disabled. But it was really 1981, the United Nation's International Year of the Disabled, that spurred us to action. It was in 1981 that we established an Advisory task force, which included eight disabled people, and which set about finding practical and pragmatic solutions to actual problems in actual services.

I emphasize that phrase, because it's the key to what we asked and expected this task force to do. In a minute, I'll tell you how they went about it, what they found, and what they recommended. But first I want to outline some of the broader principles on which CN Marine policy on transportation of the disabled eventually became based. These principles may be lengthy, but they're important because they establish the context in which changes have been made to our services since 1981.

Our starting point was the basic principle that the physically disabled should enjoy access to services provided by CN Marine comparable to those enjoyed by other Canadians. Given this premise, we decided that:

1) The onus should be on the company to show why a limitation to travel should be imposed, rather than on the consumer to prove a right to service.

2) All disabled travellers should be assumed to be self-reliant unless they choose to travel with an attendant.

3) Disabled people should not be subject to special terms and conditions for carriage when travelling alone, such as the waiving of liability.

4) CN Marine should not be required to provide "extraordinary" care of disabled passengers while travelling, such as assistance in breathing, eating or using washroom facilities.

5) Disabled persons who require special services should be responsible for identifying their needs to the company; and

6) In consultation with disabled people, CN Marine should be responsible for establishing reasonable procedures for assisting passengers with special needs, and for monitoring facilities, in an on-going fashion, to see that they're accessible.

With those basic ideas in mind, we selected a group of eight people — two from each of the four Atlantic Provinces — who were actively involved in their own communities in improving the lot of the disabled. As well, they represented a range of disabilities. The group included two paraplegics, a triple amputee, two blind people, one with impaired hearing, a woman with multiple sclerosis and another with rheumatoid arthritis.

I'm sure many of you would know some of the people who were on our task force. I want to mention just a couple of names. Mrs. Irene MacGinn from Glovertown, Newfoundland, was our co-chairperson. Irene has rheumatoid arthritis, but for those of you who know her, you'll know that that hasn't slowed her down in the least. Not only was she mayor of her town and on the Board of the National Federation of Canadian Municipalities, Irene was on the I.Y.D.P. Organizing Committee. She was responsible for organizing training of personnel to serve the disabled in hotels and motels all across her province. She was also responsible for bringing the accessible road cruiser system to Newfoundland.

Irene had a fantastic input on our task force. Not only did she co-chair the whole thing, but she came up with many excellent suggestions particularly in the area of training personnel. Another person I want to mention is Arthur Hansen from Halifax, who is a paraplegic and a marine engineer. Arthur knows ships inside out, so he brought a practical perspective to the whole exercise. His insight into what could be done to modify vessels to make them more accessible was really quite invaluable.

So we asked this group to tell us what was wrong with our service. I want to tell you that we really put this group to the test, because it seemed like every time they set off, there was a major spring storm. They were really travelling under the worst of conditions. The tour was also a major test for our system, because frankly, we weren't really equipped to handle a group of disabled this large.

Over a period of a few months, the group travelled on every ferry and passed through every terminal. They looked at CN Marine facilities, but they also studied attitudes and abilities of employees to deal with disabled passengers. To our knowledge, this was the first time in Canada that the disabled themselves got to study a whole system. I must say that the results proved that it is the disabled themselves who are the experts. They are the ones best able to tell us what they need.

In the end, the group came up with a report which had 78 recommendations for change. I cannot begin to list today everything they suggested, though I will tell you that their attention to detail was impressive, and their recommendations were all-inclusive. They covered not only structural changes, but also ways in which CN Marine could sensitize its employees, and help the disabled plan their travel in advance. The report also recommended that an on-going advisory council be established to provide input into the design of new company facilities.

Anytime a major report such as this is written, it's normal that the authors are concerned that the study be implemented, and not just sit on a shelf somewhere. Well, I'm happy to tell you today that we have made progress in implementing many of the report's recommendations. Now, I'd like to outline what those changes are. To begin, I want to show you CN Marine's Special Services brochure. It outlines in detail what services are available for the disabled on each vessel, and in each terminal. It also gives a toll-free number where disabled passengers can call to let us know in advance about their needs.

Our main reservations office at North Sydney is equipped with a Visual Ear (TDD) to provide service for deaf people. We've advertised the special number for TDD Service in the BO-BE Productions Inc. publications. The brochure is outdated now as our fleet has undergone major changes, and some services have been added. An updated brochure will be published soon under our new identity of Marine Atlantic. One of the problems we have is in letting disabled people know about our services, so any help you or your organizations could give us in distributing our Special Services brochure would be greatly appreciated.

CN Marine/Marine Atlantic's standards have been based on the Barrier Free Design Standard D-10 produced by Public Works Canada. All of our recent vessels have been built according to these standards. Most of our existing vessels have undergone a retrofit to provide elevators from the car decks, access to the washrooms, the cafeteria line, and cafeteria and bar lounge tables. Accessible berths and cabins are also now available in many of our vessels.

Wheelchairs are now available on every ship. Emergency bells and flashing lights are in place on most ships.

Two of our vessels, The Holiday Island and Vacationland, which operate between Prince Edward Island and New Brunswick during the summer months are still not up to standards. They operate on a 45-minute crossing, and both vessels have open car decks so people are allowed to remain in their cars. At the moment, neither vessel is equipped with an elevator from the car deck. The elevator shafts and wiring are in place on both ships, but the elevators were not delivered in time to be installed for the 1986 tourist season.

We anticipate that this work will be completed by April 1987, at a cost of $400,000 for each vessel. We also plan to provide accessible washrooms on the upper decks once the elevators are in place.

As for our terminals, they are now all equipped with ramps for wheelchairs, accessible washrooms, drinking fountains and telephones. Where cafeterias exist, cafeteria lines and tables are also accessible. Visual Ears and Visual Displays of schedules are now available in terminals. There is a flashing light for boarding in most terminals. Parking spaces are also specially designated for disabled persons.

Signage in all terminals and on all vessels has been prepared according to the Barrier Free Design Standards.

New initiatives are now being undertaken on the MV Caribou, which as I have said, is our newest addition to the fleet, and is a vessel that is completely accessible. Traffic will be marshalled so that vans and cars driven by the disabled will be parked next to the elevators on the car decks. Those disabled passengers who are not driving a vehicle aboard will be transported on and off the Caribou in a specially-equipped company van.

We are now in the process of preparing a major training program that will give all out-front employees training in the care of disabled travellers. This program will be used on an experimental basis in the coming months on the Caribou. If successful, it will be extended to all services.

We are also pleased to note that Transport Canada is now in the process of preparing a video for training purposes. We're looking forward to its completion in the fall, and plan to use it in our training sessions as well.

As I've said, the task force asked that an Advisory Council on the Disabled be set up to monitor progress. That has happened, though the Council has not met for a year because of the illness of the Co-Chairperson. This group is now scheduled to meet in September, and hopefully will meet once or twice a year from now on.

As I mentioned earlier, we asked the task force to give us practical solutions to actual problems. I don't mind telling you that CN Marine was concerned about what this venture might cost. After all, we had a fleet which included vessels that were 25 or more years old, and for which the cost of conversion for the disabled could have been very high.

What we found, however, was that many of the changes were easy. I would estimate that 75 percent were put in effortlessly, and, I might add, inexpensively. Some were just poor communication, and again, that's where having a task force made up of the disabled was invaluable. Many of their ideas were simply common sense ideas based on their needs. It is something that so-called experts who were not disabled could never have given us.

Recently, I had a letter from the Managing Director of the CNIB in Toronto, Euclid Herie. Mr. Herie had a chance to travel on the MV Caribou, and his letter was full of praise for what he called the "exciting and positive innovations" that we've taken to make the Caribou accessible to the disabled. Mr. Herie lamented, though, the lack of raised tactile signage and indicators for the blind, including the lack of a tactile map of the ship which could identify the emergency evacuation area.

We welcome this kind of input, though I don't have to tell you that such equipment goes beyond the Barrier Free Design Standards. CN Marine/Marine Atlantic is open to exploring these kinds of ideas. Though cost is a factor, our main concern would be in implementing something which would not become outdated shortly thereafter. In that regard, we ask for help from groups such as your own in developing systems that will be internationally recognized, and that will last.

I believe that CN Marine/Marine Atlantic's attempt to make its services accessible has been very successful. For us, it is just another component in providing plain, good service. Especially since the Canadian Charter of Rights was enacted, the disabled are exercising their right to go places and do things on an equal footing with non-disabled Canadians. I believe that CN Marine/Marine Atlantic has done a great deal to open doors to disabled travellers in the Atlantic Region.

But I must point out that our changes will not just benefit the disabled. Senior citizens are also travelling more than ever today. I think it is an exciting trend, and in this era of early retirement, one that is likely to increase in the future. Those of us who manage to survive our lifetime without a disabling disease or injury may, with luck, face an active and mobile old age. In time, we may all be enriched because of the changes that CN Marine/Marine Atlantic has made today.

Thank you.

"THE DELTA 7" CATAMARAN

SAILING OPEN TO THE DISABLED PERSONS

Didier HAAS

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PROGRAMMES FRANCE

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"THE DELTA 7" CATAMARAN

SAILING OPEN TO THE DISABLED PERSONS

1 - What is Delta 7 ?

Delta 7 is a non-profit-making association founded in 1973 with as vocation to conceive, achieve and then spread social innovations intended to various populations having difficulties : abandoned children, unemployed youth, isolated elderly, disabled persons third world populations.

2 - One the Delta 7 programs

"Catamarans for combined crews with disabled persons together with ablebodied".

Delta 7, following its vocation, has conceived and built the prototype of a catamaran with the idea of helping disabled persons with their social insertion through a sport activity : sailing.

The essential question was to determine whether one should adapt man to technology or technology to man. It is, of course, the second hypothesis that has been retained.

Doesn't anybody feel disabled in front of a malajusted technique ? It is the case for a disabled person a traditionnal boat, and particularly on a monohull where technical and ergonomic conditions are not suited for both disabled and able-bodied persons to manoeuvre together.

The action of Delta 7 in this project was to first, finance the building of the prototype, and then to support and coordinate its spreading in France and abroad.

An other reason for Delta 7 to get involved in the catamaran project is that the economical situation does not favour social insertion through professional life and, in 1986, it is a double handicap to be both unemployed and on a wheel-chair.

And often, the sports and leasure world allow a better integration of disabled persons into the malajusted world of the able bodied.

.../...

3 - Sailing and handicap

One can easily imagine what a great victory it is for a man on a wheel-chair when he happens to be a good swimmer in a pool ! For him, as for any able-bodied person, to enjoy leasures and to practice sports is an absolute right. On this respect, we are very late and this why, everywhere, one can see the spectacular intensification of various initiatives and achievements. The Delta 7 catamaran for combined crews is part of that trend.

3.1 - An area of pioners

In France, we must admit that sailing is hardly open to the disabled persons and this mostly because boats are technically not suited : only 4 equiped monohulls allow disabled crews to sail.

What Gilles Gahinet whished was not a "hospital-boat" but a real boat where combined crews would share together the joys of the wind and the sea.

3.2 - Sailing for a paraplegic person

To be paraplegic means to be deprived of the motor functions and the sensations of the lower limbs and part of the trunk.

Moving :

Without his wheel-chair, a paraplegic person can move sitting, pulling himself with the strenght of his arms, but only on a flat and continuous surface, without difference in level and with enough points to lean on. Aboard a classical boat, he has to get over various difficulties such as access to the boat, horizontal moving, going down into the hull, etc ...

Execution of the manoeuvres :

Manoeuvres must be executed on a steady sitting position by the disabled persons and aboard a non-equiped boat, it is most difficult to use gears such as the winches and the helm when they request lateral twisted movements.

Keeping a good seated balance.

Sailing for a paraplegic person cause balance problems : as he cannot keep his balance with the use of his legs, he is more sensitive than any other to the movements of a boat like heeling or pitching; making gestures that request strenght and important trunk movements is also a cause of balance difficulties.

Restriction of motricity goes together with an important risk of skin lesions in case of too long contacts of the body with hard surfaces, bumps and sharp corners.

.../...

All these remarks have been made by paraplegics who sailed on non-equiped boats and they have been widely confirmed by ergonomists, ergotherapists and handicap specialists.

Aboard a boat which is not accessible to him, a disabled person's main activity consists in trying to cope with many obstacles connected to the design and the conception of the boat.
The need was then to imagine a boat that would neither be a "hospital-boat" specially built for paraplegics but without interest for able-bodied nor a classical boat, too maladjusted for the disabled persons to carry on a real sportive activity.

4 - The genesis of the project

4.1 - A meeting of professional skills

In 1981, Gilles Gahinet, himself hospitalized at the Functional Reeducation Center of Kerpape (Morbihan), felt the need of using his skills as nautic designer and reputed sailor to serve a noble cause : enable disabled persons to sail as active crew members on specially built boats.
The Kerpape Center supported the idea immediatly and offered to make all necessary studies for the specific equipments.
The Delta 7 association gave its agreement to promote the prototype on a national basis with as aim the social integration of the disabled persons through sailing.

A real junction of abilities and knowledge enable to build a catamaran which would be fast and suited for crews with both able-bodied and disabled members. The social, ergonomic and nautic design research team has worked over 2 years to obtain a successful result.

4.2 - The choise of a multihull

a) Heeling

When a monohull boat heels to 35 degrees, a catamaran heels only to 5 degrees. As the essential problem of people with a physical handicap is a problem of balance, the stability of the catamaran is a major reason for its choice.

b) Space

The catamaran offers a wide surface between its 2 hulls and allows easier movements and a central position for most manoeuvres.

c) Speed

On a boat, the surface of sail is proportional to the weight of the boat.

.../...

A multihull is half as heavy as a monohull and therefore, its surface of sail is also reduced by half for a two or three times greater speed. These parameters enable the "Delta 7", wich weighs 1.9 tons empty, to be a fast boat with easier manoeuvres than a monohull.

d) Technology

The progresses made in nautic design and the evolution of building materials have allowed to build multihulls able to cross the Nothern Atlantic Ocean within 8 days.
And the same way that Formula 1 racing cars are helping to improve the technology of standard vehicles, the "Delta 7" found its inspiration in the last nautic innovations and was built with the newest materials following the newest technics of yacht building.

4.3 - Important dates

. october 1982 - november 1983

Studies on specific equipments with the help of life-size models. Gilles Gahinet, nautic designer, draws the plans.

. november 1983 - november 1984

Building of the prototype at La Trinité Sur Mer (southern Brittany)

. december 1984

The "Delta 7" comes out of the shipyard. First tries.

. january 1985

During the Paris Boat Show, visit of the French Prime Minister, Mr. Laurent Fabius to the "Thalassa" stand where a model of the "Delta 7" was shown.

. march 1985

Launching of the "Delta 7" at Lorient, with Mr. Alain Calmat, then French Minister for Sports.

. april 1985 - october 1985

The "Delta 7" is brought into service at Lorient and the first trainings for combinned crews start.

. august 1985

Visit aboard the "Delta 7" of the Chinese Prime Minister's son Mr. Deng Pu Fang and of Mrs. Danielle Mitterand.

.../...

. january 1986

Presence of the real catamaran at the Paris Boat Show.

. april 1986 - october 1986

The "Delta 7" is being used as school boat by the National Sailing School of Quiberon (Southern Brittany).

4.4 - The conception : 2 years of studies for the "Delta 7"

The ergonomic research :

During 2 years, a team of ergonomists, ergotherapists, physiotherapists, sports teachers, doctors have made an ergonomic study concerning the various equipments of the catamaran. Life-size models enabled to better define the problems of sailing disabled persons and to determine appropriate technical solutions. Therefore, persons with motory and sensitive troubles of the lower limbs and part of the trunk and particularly paraplegics have been put in situation of sailing. They were all different in their age, morphology, training and in the level of their lesion.

Confrontation with the designer were necessary to check the compatibility of the equipements for combinned crews with the building techniques of boat. Alterations will probably be necessary when the laboratory-prototype will actually sail. On this new catamaran, though a minimum comfort exists, a larger space for a central manoeuvres platform has been profered to habitable space.

The equipments offered :

a) Access on board

One can get on board on the side by the side of the hulls by transfering a wheel-chair, which is more or less easy according to the harbour equipments.

b) Moving through the cokpit

Sitting circulation is done on a flat, continuous, U-shaped bench, without bumps nor sharp corners and stuffed to avoid skin lesions.

c) Going down into the hulls

The solution retained has been an opening on the sides with direct access to the U-shaped bench as well as steps to soften the companion way together with a double banister system at a good leaning height that makes sitting moving easier; self stopping safety harness will be used to prevent falls in case of los of balance.

d) The seated position and manoeuvring

Almost all manoeuvres are accessible on a sitting position in the cockpit.
The shape and the size of the seats and backs, the addition of accessories (tip-up armrests, straps and front leaning bars) are meant to give comfort and stability during manoeuvres as well as during resting moments.
The self-stopping winches have several speeds and are placed for an optimal use.

e) The helmsman position

The choice has been of 2 wheel helms; This allow a better visibility when sitting as well as an easier change of position. Folding seats enable able-bodied persons to steer standing.
The size of the "mini-cockpits" ans the angle of the column of the wheel helm allow comfort in sitting position and make shifting easier.

f) Inside equipments

The kitchen bloc (stove and small sink) is placed near the center board case and, as well as cupboard spaces, is in a reachable area.
Toilets (one in each hull) are placed at the middle level and equiped with backs, armrest and non-slip coating.
The chart-table is placed at the level of the upper seat and thus makes taking bearing easier.
Lower benches for moving enable an easy access to the berths.

The building of the prototype :

The building of the "Delta 7" prototype started on november 15th. 1983 at the B and B shipyard at La Trinité Sur Mer.

It was built following the modern techniques of the big racing catamarans. Hulls are made of airex foam and fiberglass. These materials enable to obtain a light and fast boat (1.9 tons empty).

The B and B shipyard had previously built :

. Gérard d'Aboville's dinghy "Capitaine Cook" aboard which he as rowed accross the Atlantic

- The central nacelle of the catamaran "Roger et Gallet" (skipper : Eric Loizeau)
- Philippe Poupon's half ton boat (winner of the Figaro Singlehanded race 1986)

5 - The way the prototype is used

The "Delta 7" prototype, based in southern Brittany, started its operating season in march 1985.

The first. season enabled to confirm the performances of the specific equipments as well as the speed possibilities. During the Multihulls Trophy of La Trinité Sur Mer, the "Delta 7" won one leg in its class with 2 able-bodied and 2 disabled crew members.

In 1986, it will be based at the National Sailing School of Quiberon (Brittany) and will welcome 6 to 10 trainees at a time. It will also take part in a few races.

It worth noticing the exeptional attention payed by the public and the mass-media to this project.

6 - The spreading

6.1 - Generalizing the project

Delta 7 wishes first to generalize this type of boat and, 5 new catamarans are planned for 1988.

The presence of the "Delta 7" in Paris in january 1986 during the Paris Boat Show allowed potential national and international partners to know it better and eventually to think of building the same boat.

Contacts have already been taken with Canada, Japan, China and Germany and we do wish that, in the future, this wonderful boat will be the way for every disabled person who wishes so to sail.

6.2 - The evolution of mentalities

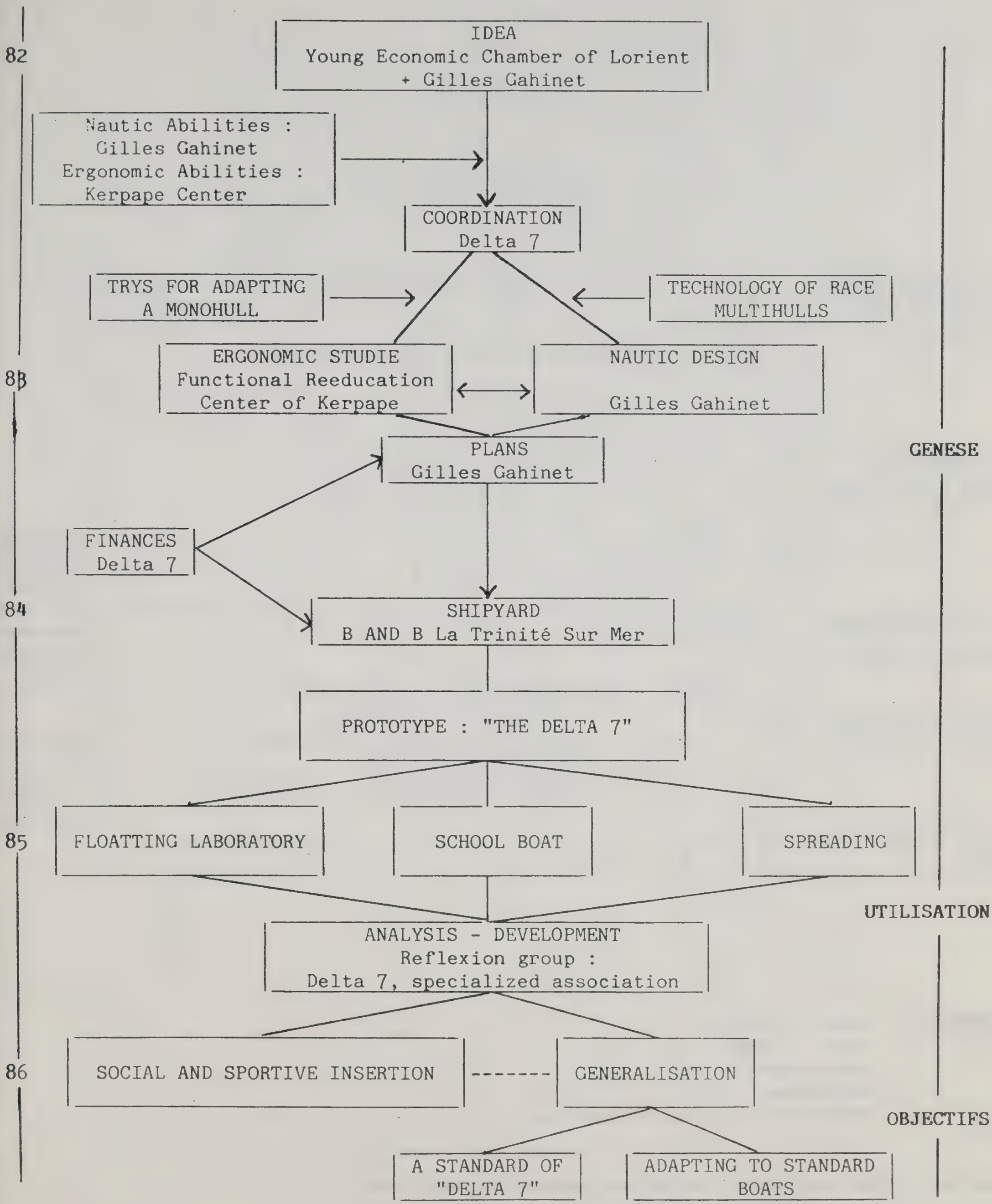
This catamaran is a good pretext to think about the capacities and deep whishes of persons who are not like the majority; it is also a good way of fighting prejudices against them.

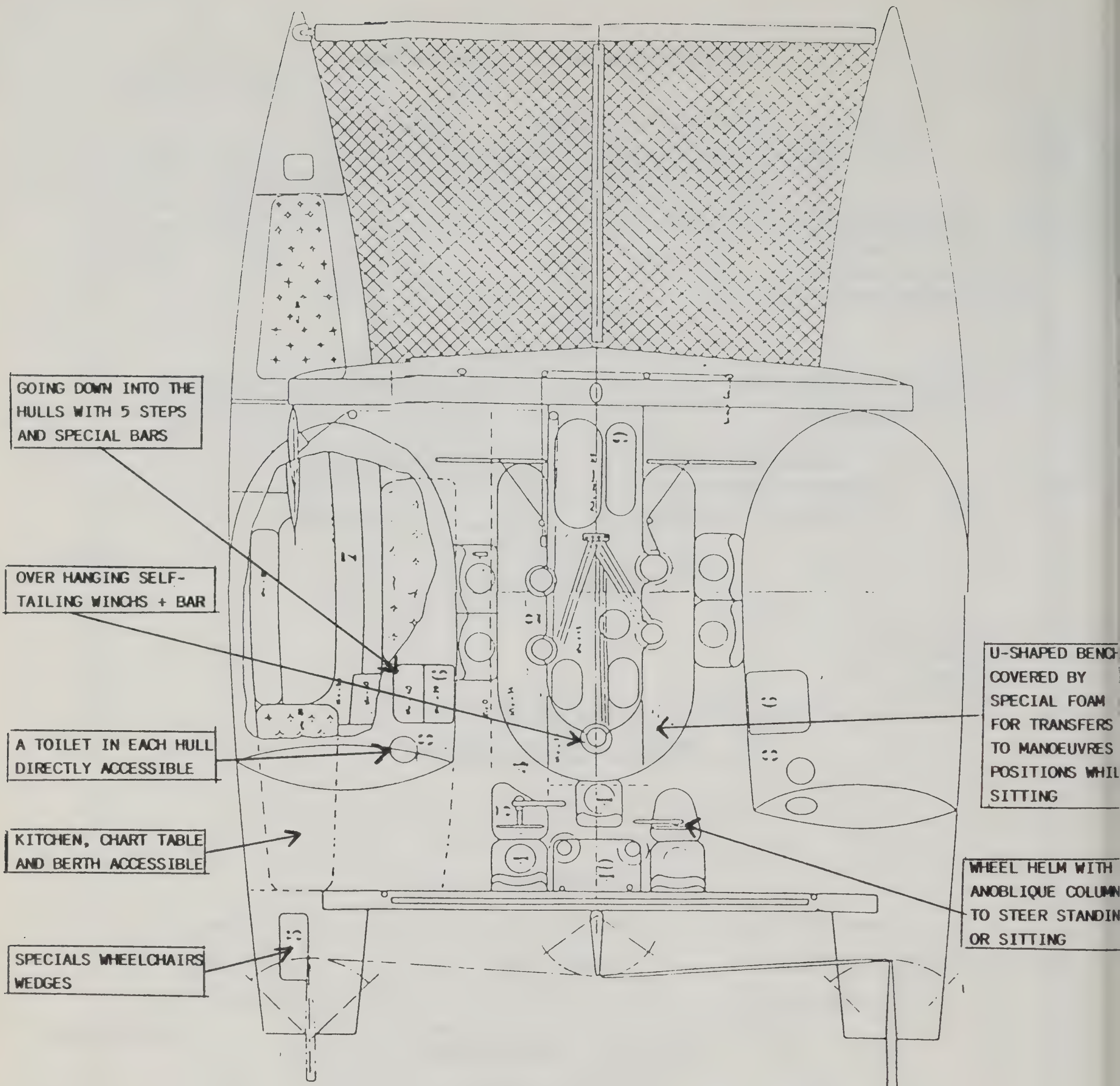
Changing mentalities is a long work. It is obvious that certain countries have quickly started to adapt cities architecture, work places, leasure equipments to make them more accessible to the disabled. On this respect, France is considerably late despite the millions of disabled persons who whish to be better integrated into the professional and leasure worlds.

Sailing, from which they are traditionally turned out, is one the favourite sports for their integration.

A group of research composed by specialists of the social areas of reeducation and sailing will soon be created with as tasks to reflect about the using of multihulls by combinned crews and to set up a dialogue with boat builders and nautic designers in order to persuade them to integrate accessible equipments to their standard boats.

ORGANIZATION CHART OF THE PROGRAM





CHARACTERISTICS : Length : 11 meters
Width : 7 meters
Empty weight : 2 tons
Sail surface : 185 m2
Materials : Airex, Epoxy, Fiberglass

Informations : Didier Haas, Delta 7, 24, rue Marc Seguin 75018 PARIS France
Tél : 1.42.02.42.22

AIRCRAFT BOARDING

OF

WHEELCHAIR PASSENGERS

Terminal to Aircraft Transfer

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1. INTRODUCTION

A major problem exists in Canada in boarding wheelchair passengers onto aircraft when a suitable system connecting the terminal to the aircraft is not available. As well as being time consuming, the process of moving the wheelchair passenger out of the terminal, across the ramp, and raising the passenger to the aircraft door involves considerable discomfort for the passenger and for the airline personnel. In Canada climate is yet another aspect to be considered.

This paper describes the first two phases of a study to improve boarding systems and procedures in the absence of a direct connection between the terminal and the aircraft door. The objective of the study is to select and demonstrate boarding systems that would provide a safe and dignified means of transferring wheelchair passengers onto aircraft in Canada.

In Phase 1[(1)], TDC researchers identified and assessed existing and proposed boarding equipment and procedures. In Phase 2[(2)], TES Limited of Ottawa carried out a detailed assessment of the most promising boarding devices and prepared a plan for the Phase 3 demonstration.

This paper describes the reason for the study, the methodology, the findings, and conclusions, and recommendations for the demonstration phase of the study.

2. BACKGROUND

In recent years heightened public awareness of the mobility difficulties of the disabled, and increased frequency of air travel by this group have drawn attention to the problems associated with the enplaning and deplaning of elderly and disabled passengers - especially wheelchair users.

Although the transfer process, from the terminal gate to the aircraft, is the responsibility of the airline carrier, Transport Canada Airports Authority Group acknowledged that government involvement was required to assist both carriers and disabled passengers in finding solutions to aircraft boarding problems.

To this end, the Transportation Development Centre of Transport Canada (TDC) was tasked in 1983 to assess current practice of boarding wheelchair passengers into aircraft. Also, the Minister of Transport commissioned a special report to examine and recommend "Air Accessibility Standards for Disabled and Elderly Persons"[(3)], and a complementary study to examine "Accessibility in Transport Canada Owned and Operated Airports"[(4)]. The findings of these studies recognized that the key issue with respect to air travel is access to the aircraft, and airport services and facilities.

2. BACKGROUND (continued)

The notion of "reasonable accommodation" was introduced and has been reinforced by Transport Canada's policy statement of January 1984, "To ensure the provision of safe, reasonable and equitable access to transportation modes under federal jurisdiction and to remove the barriers to travel, both physical and attitudinal, experienced by disabled persons"(5), and by the coming into force of Section 15 of the Canadian Charter of Rights and Freedoms on April 17, 1985, which prohibits discrimination on the basis of "mental or physical disability".

At present there are 153 federally owned airports in Canada. Of these, Transport Canada is responsible for the operation of eighty-nine. Except at major airports, where loading bridges are generally available, wheelchair passengers must be manually or mechanically boarded. Manual boarding, carrying the passenger up the aircraft stairs, or transferring the passenger into a boarding chair and carrying both up the stairs, is current practice at the majority of Canadian airports.

The necessity to provide appropriate mechanical boarding equipment, in terms of passenger comfort and safety, and airline and airport efficiency and economy, has become a priority.

3. METHODOLOGY

In Phase 1 of the study to assess the current practice of boarding wheelchair passengers onto aircraft, the methodology involved the use of a questionnaire survey form distributed internationally to airlines and airports. Details were requested on both boarding procedures and equipment in use. In addition, data was collected and synthesized from a survey of relevant literature, and through personal contacts with representatives of industry organizations such as the International Air Transport Association (IATA), the Air Transport Association of Canada (ATAC), the American Air Transport Association (AATA), with airline and airport personnel and with the Access to the Skies program. Questionnaires were sent to the 109 members of IATA and to member carriers of ATAC and AATA. A total of 85 responses were received. Questionnaires were also sent to a random selection of international airport authorities and to all Transport Canada airports as a means of cross checking on information provided by the airlines. Fifty-four international airport authorities and 108 Transport Canada airports participated in the survey. The collected information was then analyzed to develop finding.

To conduct the detailed evaluation of mechanical boarding devices in Phase 2, TES Limited developed criteria against which the candidate systems recommended for further investigation in Phase 1 were assessed. Contact was established with suppliers and manufacturers to augment existing information obtained in Phase 1 and all candidate devices were evaluated as to their conformance with the five criteria judged as essential requirements.

3. METHODOLOGY (continued)

Site visits were made to Mirabel (Quebec), Chicago (Illinois) and Windsor (Ontario) airports where field evaluations were conducted on the short list of devices meeting the criteria. The systems, with the exception of the forklift with pallet, were examined in detail taking into account physical, operational, and mechanical factors, capital and operating costs, safety, and the potential for improvements. The findings were then analyzed to determine the final conclusions.

4. FINDINGS

4.1 Phase 1:

The Boarding Procedure

Phase 1 findings confirmed that the boarding process varies considerably from country to country. In North America boarding is a carrier responsibility, and in Canada it is general practice for the wheelchair passenger to remain in his own chair right up to the aircraft door. However, at many airports, carriers transfer the wheelchair passenger into a boarding chair before this point, for example, the check-in counter, or departure lounge. Because the boarding chair proved to be an integral part of the transfer process a brief survey of chairs currently in use was conducted. In the U.S. all respondent carriers reported using some sort of boarding chair. In Canada only 36% of carriers reported using this equipment. This is no doubt because of the higher percentage of remote airports and the numerous small airlines that serve them do not maintain boarding equipment.

The Boarding Chair

The generic boarding chair is often derisively referred to as the "Washington Chair" and is usually a bare bones, narrow, high backed chair with straps to secure the passengers. However, there are several innovative chairs on the market, and in service. For example, the dual purpose Manten Airport Buggy and the Streamliner both allow self propulsion in the airport. With the large rear wheels removed they can negotiate narrow aircraft aisles. The Streamliner also folds compactly for in-flight storage. Yet, despite recent innovative developments the boarding chair remains a source of passenger complaints regarding safety, comfort and independent mobility.

Mechanical Boarding Devices

When not manually lifted, the boarding chair may be used in conjunction with four categories of mechanical boarding devices:

- o **Powered Stairway Climber**
- o **Combined Stairway and Powered Lift Platform**
- o **Forklift with Pallet Device**
- o **Vehicle with Vertical Lift Compartment**

Powered Stairway Climber

The battery operated Powerlift Stair Chair, manufactured by the Edrey Company in the U.S. climbs the aircraft stairs by means of cleats that grip the stair edge. Two attendants are required to operate the system. Although the Edrey is widely used in the U.S. it has not gained acceptance in Canada. Carriers reported that it is slow, and passengers are exposed to the elements.

The second device identified was the European manufactured Stair Aid, a portable battery operated dual-tracked unit. A standard wheelchair can be tilted, pulled back, and locked in to place. Manoeuvring the chair at the top of the stairs was found to be difficult on smaller aircraft such as the F-27. At the time of the survey five carriers utilized the Stair Aid or one its equivalents.

Combined Stairway and Powered Lift Platform

Examples of devices utilizing the boarding stairs are the Norwegian built Combi Stair and the Dutch Monoclimber. Both systems feature elevating wheelchair platforms which do not impede regular passenger boarding. These units are compatible with aircraft heights from 2-3.4 metres (up to a DC-8). Two attendants are required to operate the systems, and the Monoclimber requires the use of a special boarding chair. These devices were developed in response to the needs of the Nordic airlines, which found that the largest share of air traffic in the Nordic countries was carried by medium sized aircraft with threshold heights from 2 to 3.3 metres.

Forklift with Pallet Device

The forklift is compatible with aircraft with threshold heights up to that of a DC-9. Pallets, securements, restraints, and safety features vary greatly. There is generally no protection from the elements and the highlift telescoping mechanism does not provide sufficient fore and aft stability. In an attempt to render this equipment more appropriate for boarding wheelchair passengers many airlines have developed special pallets, some with enclosed sides and wheelchair securements, and others (Quantas and TWA for example) with fully enclosed cabins. Because the forklift is so universally used it is not surprising that eleven carriers reported using a specially designed wheelchair pallet with this lifting device.

Vehicle with Vertical Lift Compartment

The service vehicle, usually an unmodified galley truck, was the unit most frequently used to access wide-bodied aircraft. Because of its capacity, security, and protection from the elements it is often used to board groups, such as wheelchair athletes. Twelve carriers reported using readily available galley trucks. Nevertheless, this is a most undignified - and often unclean - boarding device. A problem also arises if it is not fitted with a platform

to elevate the wheelchair passenger from the ground to truck level. In this case the wheelchair passenger must be manually lifted into the truck.

Because the high-lift scissors concept is appropriate, several carriers have converted service vehicles for use as dedicated wheelchair passenger boarding equipment. Nine specially designed vehicles were identified in the survey. The table below identifies the vehicles, airlines and airport locations of this equipment. Although the majority are carrier owned, several are the responsibility of the airport authority, or are a shared responsibility.

TABLE 1. SPECIALLY DESIGNED MECHANICAL BOARDING EQUIPMENT

EQUIPMENT	AIRLINE	AIRCRAFT TYPES	AIRPORT LOCATION
o Trepel Lift-O-Mobil	South African Airways Iran Air	Lifts up to 5.6m.	Johannesburg and Cape Town Teheran
o Hastings Deering Handicapped Passenger Lift	Quantas Airways Ltd.	727, 737, 747 and upper deck of 747	Sydney
o Ansett Airlines Passenger Service Unit	Ansett Airlines	727 and 737	Adelaide and Coolangatta Planned for Perth and Brisbane
o Norwich Coach Works Invalift	British Airways	All types in service	Heathrow
o Edbro Invalid Van		Lifts up to 4.27m.	Glasgow
o British Airways boarding unit	British Airways	All except Concorde	Belfast and Glasgow
o Trans Australian boarding unit	Trans Australian Airways		Brisbane
o Societe Albert d'Avion unit	Cyprus Airways	All types	Larnaca
o Nordco Invalid Passenger Lift	Trans World Airlines	737 and 747	U.S. Airports without loading bridges

Finally, the <u>Plane-Mate</u> or <u>PTV</u> is essentially a mobile departure lounge which transports all passengers from the terminal building across the ramp to the aircraft, where it elevates to the aircraft door. PTVs are universally used at Mirabel International Airport, and are available at Dulles International Airport in Washington, Lester Pearson International in Toronto and Edmonton International in Alberta.

PTVs, once thought to be the universal solution to the boarding problem, have fallen from favour as recently designed airports feature aircraft docking in conjunction with loading bridges.

The use of loading bridges is also seen as a universal boarding solution. Both carriers and airports see the wheelchair boarding problem diminishing as new airports are built, and as older airports are undergoing renovation, with the needs of the disabled in mind. However, airport renovations usually proceed slowly, and small airports will probably never warrant extensive renovations.

4.2 Phase 2:

4.2.1 Selection of Boarding Devices for Initial Evaluation

Thirteen of the mechanical boarding devices identified in Phase 1, and recommended for further assessment, were selected in the initial evaluation. As the four basic mechanical lifting concepts described in Section 4.1 were accounted for in this selection process, and as the Phase 2 search failed to identify any significantly new or different boarding concepts, it was determined that the range of devices was sufficient in scope.

4.2.2 Development of Assessment Criteria

In order to select boarding devices for detailed assessment the following criteria were developed in terms of operational, ergonomic, mechanical and safety features considered essential to the design:

1) The devices must be capable of servicing aircraft ranging in size from a DC-9 up to a 747. If it cannot service this entire range, its minimum range must be capable of servicing the DC-9, 737 and 727. This will enable the device to operate at the smaller airports that typically do not service aircraft larger than a 727.

2) The device must comply with applicable Canadian motor vehicle and handicapped transportation safety codes and standards.

3) The device must be capable of safe operation in adverse weather conditions such as snow, rain, ice, temperatures of -35°C to +40°C, 95% humidity and cross winds of 60 knots. The wheelchair passenger must be sheltered from the elements.

4) The device must be capable of transporting handicapped passengers from the terminal gate to the aircraft door without manual elevation.

5) The device must be capable of transporting a minimum of one wheelchair passenger and an attendant. If an attendant cannot be accommodated in or on the device, he must be within reach of the wheelchair passenger at all times.

The five criteria evolved from a detailed look at various factors. Factors examined for the first criterion on operational considerations included the range of types of aircraft to be serviced, size of airports, level of usage of service by wheelchair passengers and multipurpose versus dedicated design. For the second criterion on safety considerations, compliance was considered necessary with such standards and regulations as Transport Canada's Motor Vehicle Standards, provincial Motor Vehicle Acts, Canadian Standards Association (CSA) Safety Code for Elevating Devices for the Handicapped, provincial elevator and lift requirements, CSA standards for Motor Vehicles for the Transportation of Physically Disabled Persons, and Transport Canada's design specifications for airside vehicles. The third criterion took into account the Canadian weather conditions to which equipment, personnel and passengers are subjected. The fourth criterion resulted from an examination of ergonomic considerations such as ease of access and egress, comfort, and physical abilities and limitations. The final criterion was based on factors such as passenger capacity, safety and psychological well being of the passenger during the boarding process.

4.2.3 Selection of Devices for Detailed Assessment

Data gathered from suppliers and manufacturers and information from owner/operators were used to select devices for the final detailed assessment. Of the 13 devices rated against the five criteria, eight devices met all the requirements as shown in Table 2.

TABLE 2. ASSESSMENT OF CANDIDATE DEVICES

CRITERIA	CANDIDATE DEVICES												
	PLANE-MATE (Airside Systems)	GALLEY TRUCK (Mitchell)	ELECTROVATOR (Nordco)	STAIR TRAC (Sunwa Sharyo)	POWER LIFT STAIR CHAIR (Edrey)	FORKLIFT WITH PALLET (Air Canada Design)	COMBI STAIR (Norweld)	MONOCLIMBER (J. deReus)	INVALID PASSENGER LIFT (Nordco)	LIFT-O-MOBIL (Trepal)	HI-LIFT (Edbro)	H.E.L.P. (SOVAM)	HANDICAPPED PASSENGER LIFT (Hastings Deering)
1. Capable of servicing aircraft ranging from DC-9 to a 747. If not, minimum range is from DC-9 to a 727.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
2. Capable of complying with all applicable safety standards.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
3. Capable of operating in adverse weather conditions.	Y	Y	N	N	N	Y	Y	N	Y	Y	Y	Y	Y
4. Capable of transporting wheelchair passengers from the terminal door to the aircraft door. Pasenger is never manually elevated.	Y	Y	Y	N	N	Y	N	N	Y	Y	Y	Y	Y
5. Capable of transporting minimum of one wheelchair passenger and an attendant.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

LEGEND: Y = Meets the criterion.
N = Does not meet the criterion.

Of these, the Plane-Mate, Lift-O-Mobil, galley trucks and forklift with pallet are operated in both North America and Europe, while the remaining four are operated exclusively in Europe and Australia. As these latter devices bear close resemblance to either the Lift-O-Mobil or Plane-Mate, and considering the practicality of the situation, only those operating in North America were selected for detailed assessment.

4.2.4 Detailed Assessment of Selected Devices

Part of the detailed assessment included site visits. The Plane-Mate was evaluated at Mirabel Airport (Montreal), the Lift-O-Mobil at O'Hare Airport (Chicago) and the galley truck at Windsor, Ontario. As the forklift with pallet varied in design from airport to airport, an Air Canada device was selected and evaluated using design drawings.

The detailed assessment involved the comparison of the physical, operational and mechanical factors, capital and operating costs, and safety related characteristics. The findings were as follows:

Physical

a) The Plane-Mate required considerable clearance due to its size (14.9m X 5.5m X 7.6m) and only airports specially designed to accommodate this device could benefit from its features.

b) The Lift-O-Mobil, Mitchell galley truck and forklift with pallet could easily manoeuvre around airside traffic and terminal building areas.

c) The Plane-Mate, Lift-O-Mobil and galley truck could be equipped to handle four or five wheelchair passengers while the forklift with pallet could handle only one.

d) The interior environments of the Plane-Mate and the Lift-O-Mobil were excellent, but major modifications would be required for the galley truck and forklift with pallet to bring them up to acceptable standards.

Operational

a) The Plane-Mate, Lift-O-Mobil and galley truck could safely handle aircraft ranging in size from DC-9 to 747. The forklift was capable of handling the DC-9 and 737 with relative safety but instability would be a problem with a higher lift.

b) The Plane-Mate was designed for direct docking with the terminal building, unlike the other three which would require ground level boarding. All four were capable of direct docking with the aircraft.

4. FINDINGS (continued)

Mechanical

a) All four devices were deemed to be of sound mechanical design. Drive components were to industry standards and spare parts were readily obtainable.

b) The Plane-Mate required a special service bay for maintenance.

Capital and Operating Costs

a) The equipment cost (1985) ranged from a high of $730,000 for the Plane-Mate to $132,000, $112,000, and $31,000 respectively for the Lift-O-Mobil, galley truck, forklift with pallet.

b) The operating and maintenance cost derived from service records indicated that the Plane-Mate cost $110.00 per hour; the Lift-O-Mobil $1.10 per hour; the galley truck $3.00 per hour; the forklift with pallet $1.60 per hour.

Safety

a) The four devices were found to be in compliance with the associated Canadian motor vehicle standards. The Lift-O-Mobil, as the only vehicle dedicated to transporting disabled passenger, could be modified at reasonable expense to comply with CSA Standard D409.

b) When CSA Standards D409 and B355 were used as guidelines, the Plane-Mate was found to be substandard with regard to securement of wheelchairs and restraint of the wheelchair passenger. The forklift with pallet was lacking in many areas such as securement, restraint, comfort, protection and safety.

5. CONCLUSIONS

The detailed assessment of the four selected boarding devices concluded that:

The Plane-Mate, by virtue of the need for a specially designed terminal and because of its enormous capital, operating and maintenance costs, is not a practical solution to the problems associated with boarding wheelchair passengers.

The Lift-O-Mobil (see Figure 1) is well equipped to assure wheelchair passengers safe and dignified boarding. This compact, manoeuvrable vehicle appears to be mechanically reliable based on information gathered at O'Hare Airport. The cost is approximately $132,000, with an estimated $10,000 additional cost for modifications to comply with Canadian standards. Investment of this level is viable for major airports where the demand level is highest.

The galley truck (see Figure 2), when appropriately modified meets the criteria for a suitable boarding device, at a potentially lower cost if a surplus vehicle is available. Modification costs are estimated at $50,000.

The forklift with enclosed pallet (see Figure 3 for example) was found to be the only cost effective boarding solution for small airports where passenger volume does not warrant a dedicated unit. The cost of a specially designed and equipped enclosed pallet will vary according to design. Forklifts are usually available at airports. The average purchase price of a forklift is approximately $30,000.

A demonstration program is required to confirm the suitability of the Lift-O-Mobil, the modified galley truck and the forklift with enclosed pallet to meet the requirements for transferring wheelchair passengers between the terminal and the aircraft, and to ensure the optimum distribution of the most suitable equipment at Canadian airports.

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FIGURE 1. LIFT-O-MOBIL

FIGURE 2. GALLEY TRUCK

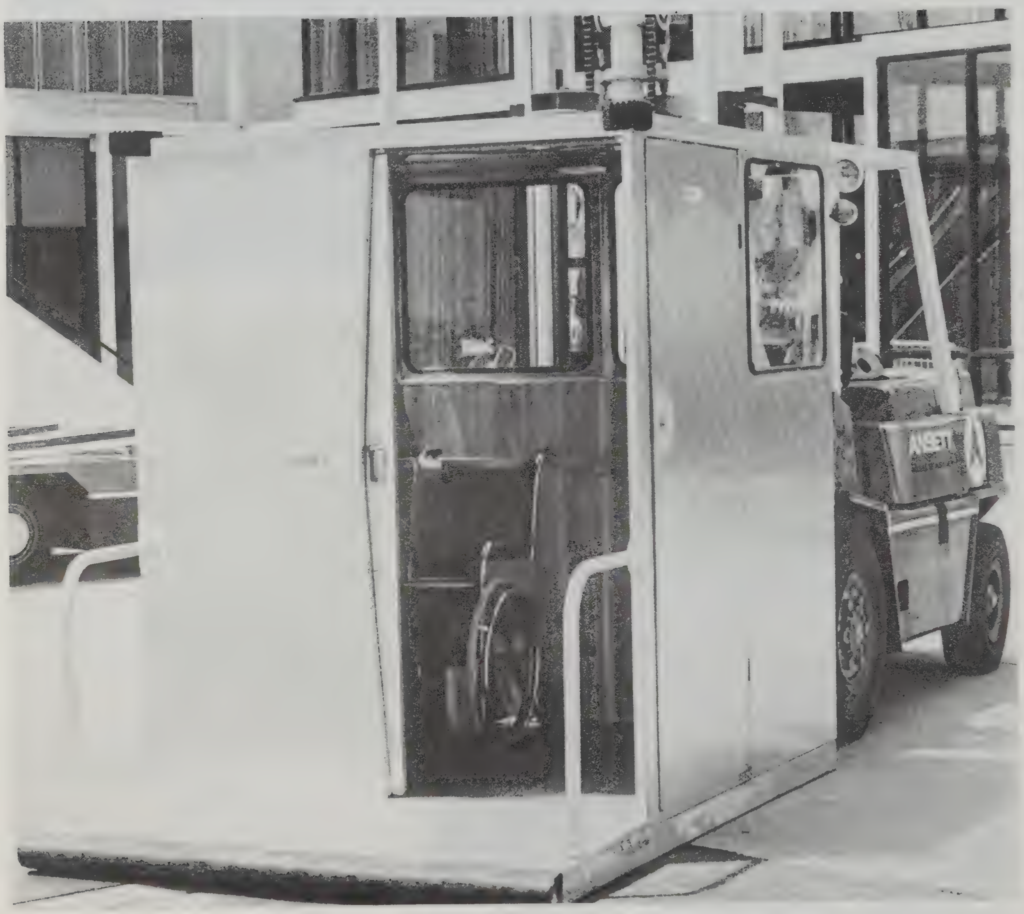

FIGURE 3. FORKLIFT WITH ENCLOSED PALLET

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TRAVEL TIPS - HELPING US TO HELP YOU

BARBARA DUNN
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CANADIAN AIR LINE FLIGHT ATTENDANTS' ASSOCIATION

TRAVELLING BY AIR HAS BECOME SECOND NATURE TO MANY OF US, AND RIGHTLY SO. IT IS THE SAFEST, MOST COMFORTABLE MEANS OF TRANSPORTATION AVAILABLE TO US. TAKING IT FOR GRANTED CAN HOWEVER CAUSE SOME PROBLEMS FOR THOSE OF YOU WITH SPECIAL NEEDS AS THERE ARE TIMES WHEN YOU FEEL THE AIRLINE SHOULD BE ABLE TO MEET THOSE NEEDS WITHOUT ADVANCED WARNING. WHAT I WOULD LIKE TO DO OVER THE NEXT TEN MINUTES IS OUTLINE SOME OF THE AREAS WHERE YOU CAN HELP US TO HELP YOU.

BEFORE THE FLIGHT

WHEN YOU MAKE YOUR RESERVATIONS BE SURE TO TELL THE AIRLINE OR TRAVEL AGENT WHAT YOUR SPECIAL NEEDS ARE, E.G.:

- DO YOU NEED A WHEELCHAIR;
- ARE YOU REQUIRED TO HAVE A SPECIAL MEAL;
- DO YOU NEED EXTRA OXYGEN DURING THE FLIGHT;
- IS THERE A MEDICAL CONDITION THE CREW SHOULD KNOW ABOUT, I.E. HEART CONDITION, DIABETES, ASTHMA, ETC.

IF WE DON'T KNOW ABOUT THESE THINGS AT LEAST 48 HOURS IN ADVANCE, IT WILL BE DIFFICULT TO ATTEND TO YOUR NEEDS IN THE TERMINAL AND ONBOARD.

WHEN YOU ARE PACKING FOR YOUR TRIP BE COGNIZANT OF WHAT YOU ARE GOING TO BRING ON BOARD AND TRY TO KEEP IT TO A MINIMUM. SPACE IN AN AIRCRAFT CABIN IS LIMITED FOR CABIN BAGGAGE AND ANYTHING YOU HAVE SHOULD NOT BE LARGER THAN 9" X 16" X 20". YOU SHOULD ALSO BE AWARE OF THE WEIGHT OF YOUR CABIN BAGGAGE. IF IT IS TOO HEAVY, YOU ARE RISKING BACK INJURY FOR YOUR FLIGHT ATTENDANT AS SHE TRIES TO PLACE THE BAG IN THE OVER-HEAD BIN. THE MOST IMPORTANT REASON TO LIMIT YOUR CABIN BAGGAGE HOWEVER, IS THAT IT CAN INTERFERE IN AN EVACUATION. ACCIDENT REPORTS HAVE POINTED OUT THAT PASSENGERS WERE NOT ABLE TO LEAVE AN AIRCRAFT BECAUSE THE EXITS OR ROUTES TO THE EXITS WERE BLOCKED BY CABIN BAGGAGE.

BE SURE TO ARRIVE AT THE AIRPORT AT LEAST ONE HOUR PRIOR TO DEPARTURE. IN THESE DAYS OF DEREGULATION YOU MAY NOTICE A DECREASE IN AIRPORT STAFF AND IT IS HELPFUL TO EVERYONE IF YOU GIVE US THE TIME TO SERVE YOU PROPERLY. IT IS ALSO AN ADVANTAGE IF YOU ARRIVE AT THE GATE IN TIME TO BE PRE-BOARDED, I.E. ONE HALF HOUR BEFORE DEPARTURE.

BEFORE TAKE OFF

IF YOU ARE ABLE TO BE PRE-BOARDED, AND DEPENDING ON YOUR DISABILITY, YOU SHOULD EXPECT A PERSONALIZED BRIEFING BY YOUR FLIGHT ATTENDANT ON EMERGENCY PROCEDURES. IF HOWEVER, THIS IS NOT POSSIBLE BECAUSE OF TIME, YOU SHOULD MAKE YOURSELF AWARE OF THE FOLLOWING:

A) LOCATION OF YOUR NEAREST EXIT;

B) LOCATION OF AN ALTERNATE EXIT;

C) PROPER USE OF YOUR SEATBELT - HOW TO FASTEN AND UNFASTEN;

DO NOT HESITATE TO ASK YOUR FLIGHT ATTENDANT IF YOU HAVE ANY QUESTIONS.

TAKE THE TIME TO ADVISE THE CREW OF YOUR SPECIAL NEED. ONCE AGAIN, WE CANNOT HELP UNLESS WE ARE AWARE OF THESE NEEDS. THERE ARE HOWEVER TIMES WHEN DUE TO TIME CONSTRAINTS, IT IS DIFFICULT FOR THE CABIN CREW TO MEET ALL OF YOUR NEEDS. WE TRY TO DO OUR BEST BUT WE ALSO HAVE OTHER PASSENGERS WHO CANNOT BE IGNORED AND WE APPRECIATE YOUR PATIENCE AND UNDERSTANDING.

DURING THE FLIGHT

TRY TO BE AWARE OF HOW BUSY THE FLIGHT ATTENDANTS ARE. AIRLINES ARE INCREASING SERVICE AND DECREASING CREW MEMBERS AND THERE IS NOT ALWAYS TIME TO DO AS MUCH AS WE WOULD LIKE, ESPECIALLY ON SHORT FLIGHTS.

AFTER LANDING

IF YOU NEED HELP GETTING OFF THE AIRCRAFT IT IS IMPORTANT THAT YOU WAIT UNTIL ALL OTHER PASSENGERS HAVE DEPLANED. OTHERWISE IT IS IMPOSSIBLE FOR THE CREW TO OFFER ASSISTANCE. WE KNOW YOU ARE THERE AND WE PROMISE YOU WON'T BE FORGOTTEN.

PLEASE DON'T ASK THE CREW TO BRING BAGS OR COATS OUT OF THE OVERHEAD BIN PRIOR TO LANDING. EVERYTHING MUST REMAIN SECURELY STOWED FOR SAFETY REASONS. FOR THE

SAME REASONS , WE ALSO WILL NOT BE PASSING OUT PERSONAL BELONGINGS WHILE THE AIRCRAFT IS TAXIING. WE ARE REQUIRED TO REMAIN AT OUR EMERGENCY EXITS IN CASE AN EVACUATION BECOMES NECESSARY. AND PLEASE DO NOT TRY TO GET UP BEFORE THE AIRCRAFT IS PARKED AT THE BRIDGE. YOU COULD END UP IN THE TERMINAL BEFORE ANYONE ELSE.

EMERGENCY

IF AN EVACUATION BECOMES NECESSARY AND TIME PERMITTING, THERE WILL BE A FULL PASSENGER BRIEFING. DURING THIS TIME AND DEPENDING ON YOUR NEEDS, SOMEONE FROM THE PASSENGER LOAD WILL BE ASSIGNED TO HELP YOU. IF YOU ARE SERIOUSLY DISABLED WE WILL EXPECT YOU TO TELL US HOW BEST TO GET YOU TO AN EXIT. IT IS HOWEVER IMPORTANT FOR YOU TO APPRECIATE THAT WE WILL BE ASKING YOU TO WAIT UNTIL ALL OTHER PASSENGERS HAVE LEFT BEFORE PROCEEDING TO THE EXIT. THE CREW WILL DO EVERYTHING POSSIBLE TO GET YOU OUT. BUT THEY WILL NOT KNOWINGLY JEOPARDIZE THE LIVES OF OTHER PASSENGERS. THEY ARE ALSO NOT REQUIRED TO RISK THEIR OWN LIVES.

IN CLOSING, I WOULD LIKE TO EMPHASIZE THAT YOUR FLIGHT ATTENDANTS ARE ON BOARD FOR YOUR SAFETY. WHILE OUR SERVICE REQUIREMENTS ARE A BIG PART OF OUR JOB, SAFETY IS THE MOST IMPORTANT FACTOR. KNOWING THIS WILL HOPEFULLY HELP YOU TO UNDERSTAND WHY THINGS ARE DONE IN A CERTAIN WAY WHEN YOU FLY. I HOPE I HAVE BEEN ABLE TO OFFER YOU SOME HELPFUL HINTS AND I WISH YOU SAFE FLYING IN THE FUTURE.

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THE ROLES OF DEMAND-RESPONSIVE AND SCHEDULED BUS SERVICES FOR DISABLED PEOPLE

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THE ROLES OF DEMAND-RESPONSIVE AND SCHEDULED BUS SERVICES FOR DISABLED PEOPLE

1. INTRODUCTION

1.1 Recent years have seen a substantial growth in the provision of bus services which are able to carry disabled people, including those who are wheelchair-bound. Although the types of services provided vary from place to place they can be divided into two broad categories: those which are operated like the usual stage carriage or local bus services on a fixed and timetabled route, and those which are operated on a demand-responsive basis. The latter will have their geographical area defined and their hours of operation but in other respects they are run as dictated by the needs of their customers.

1.2 A number of research studies have been mounted which have looked at both types of operation. Local bus services have been considered primarily from the point of view of the type and costs of the vehicles and the adaptations necessary to allow them to carry disabled people[1]. The ergonomic aspects of this type of vehicle (specifically the single-deck Leyland National modified for use by London Buses Ltd) has also been reported on [2]. Demand-responsive services have also been examined, both individual operations [3] and more broadly in a study which considered the nature of the services offered and their cost effectiveness[4].

1.3 The purpose of the present study is to look more closely at the users of these types of services, in particular to try and place the use made of the services within the context of the total travel needs of disabled people. Perhaps inevitably where two different kinds of service are offered to ostensibly the same group of people by two different kinds of organisations there will be some dispute over which kind is the better.

1.4 A further problem and one which confronts the intending provider of such services is how, whichever type of service he elects to offer, should he plan the service? Whether it is a question of choosing a fixed route or of defining an area to be covered or of deciding the times at which the service is to be available, the intending operator faces a series of unknowns which may mean that his service will fail to achieve its full potential not through any inherent fault in the service concept but simply because insufficient is known about where disabled people live, where they want to travel to, when they want to travel, and in the broadest sense, what sort of service they would like to have. This study is intended to cast some light on these problems

2. THE SERVICE STUDIES

2.1 Five services were studied; two each in London and Glasgow and one in Doncaster. Briefly these services comprised:

Demand-Responsive Services

(i) Operated in the Paisley and Pollok areas of Glasgow on respectively Tuesday/Thursday and Monday/Wednesday/Friday from 0900 to 1600 hours

(ii) Operated in the London Borough of Haringey, seven days a week between 0830 and 2330 hours.

Scheduled Fixed Route Services (Local Bus Service)

(iii) Eight special routes in Doncaster (South Yorkshire) urban area, five with two services per week, three with one service per week. All services run to the town centre and operate day time off-peak.

(iv) Five routes in Glasgow which run to or through the city centre. These routes are operated with standard buses but with modified buses operating as well to give up to 11 journeys each way every week day.

(v) Eleven special routes in east London which run to major shopping centres in that area. Each route is operated once a week, day time off-peak.

Services (i) and (iv) are operated by Strathclyde PTE, service (ii) by the Haringey Disablement Association, (iii) by the South Yorkshire PTE and (v) by London Buses Ltd (LBL).

3. STUDY METHODOLOGY

3.1 In Doncaster, Glasgow and on LBL's services passengers were interviewed while riding on the bus to establish whether they would be prepared to be interviewed at home. These intercept surveys were limited to disabled passengers only; able bodied companions were not included. The interviewers recorded the name and address of the interviewee together with brief information on journey purpose and destination. Each interview lasted about two to three minutes.

3.2 For the Haringey Dial-a-Ride service the operator provided a listing of people who had used their buses within the last six months. The list was arranged by age of the persons concerned and comprised 240 people.

3.3 All those people who had agreed to be interviewed were then visited at home. A 50% sample was drawn from the Haringey passenger list to provide a representative number covering all age groups.

3.4 In total 247 people were interviewed; 159 from the Dial-a-Ride service users and 88 from the local bus service passengers. The numbers interviewed from individual services varied as Table 1 shows. Both the London and Glasgow local bus services had only recently started and their passenger numbers were low at the time of the survey.

4. TYPOLOGY OF USERS

4.1 Using a broad categorisation of those who use wheelchairs and those who do not the characteristics of the two types of service are different. A much higher proportion of the local bus service users are in wheelchairs than are those using the Dial-a-Ride services, particularly the Glasgow Dial-a-Ride service where only two out of the 37 respondents were in a wheelchair. As is usual with public transport services females outnumber males, with 83 per cent of the users being female. These figures are summarised in Tables 1 and 2.

Table 1

Respondents by Use of Wheelchair and Service Used

Service	Wheelchair Users	Ambulant Disabled	Total
Doncaster local bus	50	13	63
Glasgow Dial-a-Ride	2	37	39
Glasgow local bus	5	0	5
Haringey Dial-a-Ride	36	84	120
London local bus	15	5	20
Total	108	139	247
%	43.7	56.3	100

Table 2

Age Distribution of Service Users

Age group (years)	Male	Female	Total	%
10–19	1	3	4	1.6
20–29	3	10	13	5.3
30–39	4	8	12	4.9
40–49	3	8	11	4.5
50–59	2	14	16	6.5
60–69	10	47	57	23.1
70–79	15	64	79	32.0
80–89	5	47	52	21.0
90–99	0	3	3	1.2
All	43	204	247	100.0
%	17.4	82.6	100.0	

4.2 The age distribution of the users shows, as would be expected, a preponderance of older people though the absolute range was from 11 to over 90 years. About three—quarters (77%) were over 60 and about half (54%) over 70.

4.3 The disabilities of the bus users were varied, but arthritis was by far the commonest with over a third of the people suffering from it. People who had had strokes were the next most frequent but only accounted for seven per cent of the users. Almost 27 per cent of the people had had their disability for five years or less and a further 21 per cent had had it for between five and ten years. Quite a large proportion (14%) had had their disability for over 30 years.

4.4 Respondents were asked about the physical effects of their disability. The great majority (221 out of 247 or 89%) had pain, stiffness or weakness in one or both legs. Fewer people had problems with their arms (57%) while about half had problems with their trunk.

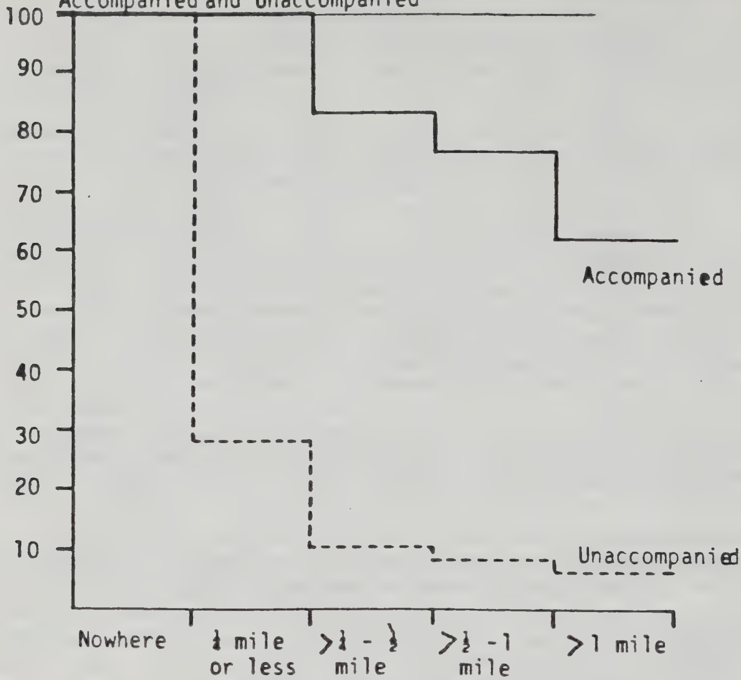
4.5 People who used wheelchairs were asked how far they were able to travel (in their wheelchair) both with and without someone to accompany them. The results are shown in Figure 1 and demonstrate the vast difference that accompaniment makes. The majority (over 70%) could not go anywhere by themselves whereas with accompaniment over 60 per cent could go distances of over a mile. Of the respondents who were able to walk the majority (67%) could walk no more than a quarter of a mile. Approximately one third of those who could walk normally went out with someone else.

4.6 To complete the picture of the respondents' lifestyle a number of questions were asked about their homes, adaptations to them, household size and car ownership and employment.

4.7 In summary the type of housing generally reflected the area in which the person lived: the largest proportion of London and Glasgow people lived in flats, in Doncaster the majority lived in houses or bungalows. Almost 10 per cent lived in sheltered homes and a further 6 per cent in hospitals or convalescent homes.

Figure 1

Wheelchair Users: Distance Able to Travel Accompanied and Unaccompanied



Note: Diagram based on data from 105 respondents specifying distance without accompaniment and 94 respondents with accompaniment.

4.8 Two-thirds of the people had had some adaptations in their home most commonly in the bathroom. Adaptations in kitchens, bedrooms and living rooms were much less frequent (all under 10%). The adaptations were usually paid for by Social Services Departments: privately paid for modifications were relatively few. A listing of houses where adaptations have been made could provide a tool in planning bus service routeing.

4.9 A very high proportion of the respondents live in one- or two-person households, respectively 37 and 35 per cent. Female respondents living alone accounted for just over 40 per cent of all the female respondents. Males were much less likely to be living alone with eight out of 43 (19%) so doing. If those people living in convalescent homes and hospitals are excluded, the figures for the percentage of females and males living alone rise to 46 and 22 respectively. Of those living alone many had done so for quite long periods: just over 39 per cent for between 11 and 50 years and just under 4 per cent for more than 50 years.

4.10 Car ownership, as might be expected, was low. Overall just under 14 per cent of respondents had access to a car, ranging from seven per cent in Glasgow to 19 per cent among Doncaster residents. Only four people out of the 247 actually drove a car: all four had adaptations to their car.

4.11 Very few of the respondents were in employment: only nine out of the 247, comprising three males and six females. These people were spread (thinly) through the 20 to 59 age groups. Similarly, the households in which all the respondents lived had relatively few other people in employment: a total of 41 comprising 37 in full-time and four in part-time work. This figure equates with approximately 10 per cent of the total number of people in the respondent households.

4.12 Although the number of people currently working was very small, the majority (76%) had worked at some time. Of these people, most had finished work more than 10 years ago as Table 3 below shows. A small number (five), all living in London, had worked beyond their 70th birthday Just over 20 per cent of the female respondents and 14 per cent of the males had never worked, these figures including the four youngest respondents aged 11 to 19 years.

Table 3

Employment Status of Respondents

	Males	Females	Total
In employment	3	6	9
Finished work:			
up to 1 year ago	1	3	4
2–5 years ago	5	16	21
6–10 years ago	11	25	36
over 10 years ago	16	110	126
Never worked	6	42	48
No data	1	2	3
Totals	43	204	247

5. ACTIVITIES

5.1 The main part of the questionnaire dealt with the activities of the respondents and the modes of transport which they used. Tables 4 and 5 summarise the data on activities.

Table 4

Respondents' Outside Activities

Service	Number and percentage of people going out to:													
	Work		Education		Day centre		Medical		Shopping		Social		Other	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Doncaster local bus	*		6	9.5	7	11.1	35	55.6	61	96.8	44	69.8	35	55.6
Glasgow D-a-R	–	–	1	2.6	7	17.9	17	43.6	29	74.4	22	56.4	27	38.5
Glasgow local bus	–	–	1	20.0	1	20.0	3	60.0	4	80.0	2	40.0	–	–
Haringey D-a-R	6	5.0	9	7.5	12	10.0	57	47.5	83	69.2	84	70.0	46	104.4
London local bus	2	10.0	–	–	1	5.0	4	20.0	11	55.0	15	75.0	12	67.3
Total	8	3.2	17	6.9	28	11.6	116	47.0	188	76.1	167	67.6	120	48.6

*One person working at home

Table 5

Trip Rates for Outside Activities (where known)

(Averages refer only to those people making that type of trip and are round trips)

Service	Total and average trip rates per person per four weeks for:													
	Work		Education		Day Centre		Medical		Shopping		Social		Other	
	Tot		Tot	Av	Tot	Av	Tot	Av	Tot	Av	Tot	Av	Tot	Av
Doncaster local bus	–	–	40	6.7	48	6.9	29	0.8	483	7.9	204	4.7	106	3.8
Glasgow D-a-R	–	–	8	8.0	88	12.6	22	1.3	283	9.8	138	6.6	39	3.0
Glasgow local bus	–	–	4	4.0	4	4.0	6	2.0	51	12.8	3	1.5	–	–
Haringey D-a-R	112	18.7	112	12.4	94	7.8	118	2.1	506	6.1	479	5.8	104	3.2
London local bus	20	20.0	–	–	8	8.0	6	1.5	137	12.5	63	4.2	67	5.7
Total	132	18.7	164	9.6	242	8.6	181	1.6	1460	7.8	887	5.4	316	3.8

Notes: Work figures available for 7 respondents only
Social figures refer to 164 persons (out of 167 making social trips)
Other purpose figures refer to 84 persons: the remaining 36 persons with those trips combined them with another purpose.

5.2 Overall the activity engaged in by the most people was shopping: 76 per cent went out for this purpose. In Doncaster almost all the respondents (61 out of 63) went out shopping. Over two-thirds of the people went out for social purposes to visit friends, recreational clubs etc. Just under half the people went out to various medical facilities and on personal business. The latter purpose was quite often combined with shopping purpose trips.

5.3 Work and education purpose journeys were made by few people. As mentioned above only nine people were working and only four were within the school age group, though a small number of older people did go to evening classes. Day centres were used by just under 12 per cent of the respondents.

5.4 In all activity categories there were quite wide variations in the proportions of people from the different services who undertook them. To some extent this no doubt reflects both the type of special bus service available to them as well as their access to private vehicles and their ability to go out by themselves.

5.5 Overall the respondents made 3382 trips over four weeks. Table 5 shows the average frequency of trips by purpose for those making that type of trip. A high average for work and education journeys could be expected (even attendance at an evening class implies four trips per four weeks) and the same would be true of day centre visits. Shopping trips, however, are also quite frequent: those who make them at all average almost two trips a week. Because the majority of the respondents do make journeys, shopping trips total 1460 in four weeks, or 43 per cent of the total. Social purpose trips account for a further 26 per cent. None of the other journey purposes accounts for more than 10 per cent of the total.

5.6 Table 6 shows the modal split for the various trip purposes. (This is based on the first or usual mode mentioned by the respondents). It demonstrates how important the special wheelchair accessible buses are. In all journey purposes except medical and education they account for a quarter or more of all the trips, rising to a high of around half of all journeys to shop and to day centres.

Table 6

Modal Split for Outside Activities: Normal Mode to Location Type

Mode	Work %	Education %	Day Centre %	Medical %	Shop %	Social %	Other %
Car driver	12.5	5.6			1.9	1.8	3.7
Car passenger		22.2		7.7	9.0	25.3	6.1
Taxi	25.0	5.6		11.9	1.9	6.6	3.7
W/C access. bus	25.0	16.7	53.6	9.5	47.3	28.2	25.0
Local bus	12.5	5.6	7.1	8.9	9.6	7.7	7.9
Other bus		33.3	25.0	0.6	0.6		
Ambulance			14.3	41.1		2.6	
Walk		11.1		7.7	15.0	7.3	27.4
In wheelchair				6.0	10.2	11.7	21.3
Other	12.5			3.6	4.2	6.2	4.9
No data	12.5			3.0	0.3		
Total	100	100	100	100	100	100	100

5.7 For all journey purposes, except to work, the great majority of respondents do not have an alternative mode available. Typically around 20 per cent of these going to education, day centre, shopping and personal business have an alternative mode available. Rather fewer (about 15%) have an alternative mode for visits to medical facilities and for social purposes. Wheelchair accessible bus services are still important as an alternative mode as Table 7 shows.

Table 7

Modal Split for Outside Activities: Alternative Mode to Location Type

(Refers only to those people using an alternative mode)

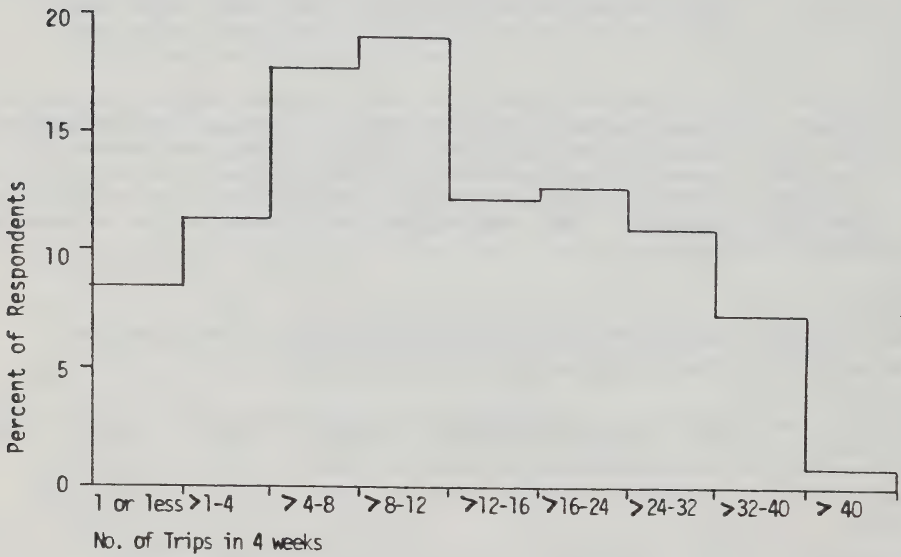
Mode	Work %	Education %	Day Centre %	Medical %	Shop %	Social %	Other %
Car driver						7.0	
Car passenger	20.0			43.5	15.3	25.6	17.1
Taxi	40.0	25.0		34.8	13.6	37.2	22.9
W/C access. bus	40.0	25.0	50.0	4.3	37.3	9.3	17.1
Local bus				4.3	13.6		25.7
Other bus				4.3	1.7	2.3	
Ambulance							2.9
Walk		25.0	16.7		5.1	2.3	8.6
In wheelchair		25.0	33.3	4.3	10.2	11.6	5.7
Other				4.3	1.7	4.7	
No data					1.7		

5.8 In comparison with the main modes (shown in Table 6) taxi and car passenger account for a higher proportion of the trips and can perhaps be regarded as fall-back modes, particularly for work, medical and social purpose journeys. Going in a wheelchair is quite important for trips to day centres and to education though this mode does not figure at all in the main modes to these two activities. Again this is presumably a fall-back when a vehicular means of transport is not available.

5.9 The overall four week total of trips (3382) has already been mentioned. Turned into an average this represents a little under 14 trips per person per four weeks, but of course there are very wide ranges at the individual level. Figure 2 shows the distribution with over 40 per cent of the respondents making more than 12 trips in four weeks and just a couple of people making over 40. At the other end of the scale five people made none at all and 16 made one a week or less.

Figure 2

Distribution of Round Trips over Four Weeks



5.10 Some comparisons of trip rates between the respondents in this survey and more general survey based data are possible. The National Travel Survey average trip rate for people aged 10 and above living in conurbations was just over 21 single trips per person per week. The averages for the London and Glasgow disabled people range from 6.4 single trips per week (Haringey DaR users) up to 7.5 single trips per week (London local bus users). Of course the national statistics show a sharp decline in trip rate by age from well over 20 single trips per week in the younger age groups (10 to 49) down to just under eight single trips per week for those people aged 80 to 89. If the NTS average trip rates are weighted by age group to match the sample in the study, then a comparison shows that the study group sample have approximately 44 per cent of the level of mobility of the population at large.

5.11 Another comparison can be made between the Doncaster respondents and.some people in Oxford who recently kept travel diaries as part of a study.into the effects of bus service reductions. The people were also bus users (though ordinary local buses, not special services) and covered all age groups from school age to retirement. They were approached in a similar manner to the Doncaster, Glasgow and London Buses Ltd passengers, that.is.by on-bus intercept surveys and they formed a random sample of the Oxford.bus passengers. On average these people (183 in number) recorded 19.5 single trips per person per week. The comparable figure for the Doncaster respondents was just over seven single trips per person per week or 37% of the Oxford average.

6. SERVICES AT HOME

6.1 Given the relatively low mobility of many of the respondents it would be reasonable to hypothesise that a substantial proportion would have services coming to them in their home. A series of questions were asked about this, covering medical services, non-medical services, and the use of mail order catalogues and mobile shops.

6.2 Table 8 summarises the data from these questions. There was considerable variation between the areas, for example more than twice the proportion of Doncaster respondents received visits at home from medical services. Visits by doctors were the most frequent (59% of those who received medical purpose visits) but calls by chiropodists and district nurses (33 and 31% respectively) were also quite frequent.

Table

Services at Homme

Area	Percentage of respondents receiving visits for:	
	Medical purposes	Non-medical
Doncaster	47.6%	46.0%
Glasgow	18.2%	25.0%
London	34.3%	38.6%
All respondents	34.8%	38.1%

6.3 As the table shows slightly more respondents received visits from non-medical services; the majority of these were from home helps but people were also visited by hairdressers, social workers and care attendants. The Glasgow respondents received noticably fewer visits at home than the respondents in either of the other two places. Possibly this was due to the Glasgow residents being generally less severly disabled than the others.

Use of Mobile Shops and Mail Order Goods

6.4 Mobile shops were only used by 21 respondents (8.5%), mostly people living in Doncaster. Almost all these people used the shops just to buy food. Most of these people were aged 50 or more. The pattern for use of mail order goods was different. More people used these catalogues and they were generally younger: the modal age group for mail order catalogues was 30 to 39; for mobile shops 70 to 79 . The use of catalogues was heavily biased towards female respondents of whom 22.5 per cent use them compared with fewer than five per cent of male respondents Mail order catalogues were most commonly used to buy clothes (77%) though over 40 per cent bought consumer durables.

7. RESPONDENT'S VIEWS OF THE WHEELCHAIR ACCESSIBLE SERVICES

7.1 Respondents were asked a number of questions on their attitudes towards the special services, the vehicles and the attendants on the buses. In all the services the respondents' reactions were overwhelmingly favourable.

7.2 On the services themselves comments such as "wonderful" and "fantastic" were commonplace. The attendants (who help passengers get on and off the bus, secure wheelchairs etc.) were universally regarded as very helpful: there was not one adverse comment. The only significant element of criticism of the services were the comments of 26 per cent of the Haringey DaR users about difficulties of getting through on the telephone to book the service or even occasionally to cancel a booking when the intending passenger did not feel well enough to go out.

7.3 Generally the buses themselves were considered at least satisfactory and quite often pleasant and comfortable. A very small number of people felt a bit nervous about using the lift mechanism but once inside wheelchair users did not mention any serious problems. The commonest criticism (though still only voiced by a minority) was about the quality of the seating. Buses (as in Glasgow DaR) with inward facing seats were not liked because people feel less secure in them. Similarly seats covered with shiny 'leatherette' or vinyl were not found comfortable by some passengers. Absence of arm rests was adversely commented on, as were some seats being too low.

7.4 Other experimental and observational work at Cranfield has shown that attention to detailing is important for many ambulant disabled people. Quite minor design changes can make a noticeable difference to the ease with which ambulant disabled people can use buses. No doubt some of the criticisms made by passengers about seating could be eliminated with similarly small scale alterations.

7.5 Respondents were also asked to suggest any ways in which the bus services or the vehicles could be improved. Better telephone booking arrangements and improved seating both figured in the answers to these questions, but for many more people the greatest improvement would be to have the service available more frequently. In addition to greater frequency many users would also like to get to other places beyond the ambit of their service. Sometimes this referred to other locations in the general area of the service (eg being able to use the Haringey DaR service to get to the West End of London) but it often also referred to places further afield which people would like to visit occasionally. Using the absence of any suggestions for service improvement as a very rough guide to satisfaction the proportion of people who did not make any suggestions were:

Doncaster Local Bus	40%
Glasgow DaR	33%
Haringey DaR	29%
London Local Bus	25%
Glasgow Local Bus	20%

The Value of the Special Services and Unsatisfied Travel Demand

7.6 Questions of satisfaction with the services lead naturally to questions about the value of the services to their users. Towards the end of the interview all respondents were presented with four statements about the special service:

1. I don't use the service much but it's nice to know it's there if I need it;

2. I use the special transport service mainly for journeys I would have made by other, more difficult, means;

3. I go out more, using the service, than I would have done previously;

4. As a result of the scheme I am now travelling to places I would never have thought possible.

7.7 They were asked to choose the one which they thought best described the value of the service to them. Overally the responses were:

Statement 1	28.2 per cent
Statement 2	17.5 per cent
Statement 3	30.8 per cent
Statement 4	23.5 per cent

These percentages relate to the total number of people who answered the question and exclude 13 respondents (all in London) who were unable to respond to the question.

7.8 Disaggregating the responses into the users of the various services shows that there is considerable variation as shown in Table 9 below:

Table 9

Responses to Statements on Value of Special Bus Services

Service	Statement chosen:								Totals	
	No 1	%	No 2	%	No 3	%	No 4	%	No	%
Doncaster local bus	6	9.5	5	7.9	28	44.4	24	38.1	63	100
Glasgow DaR	4	10.3	16	41.0	8	20.5	11	28.2	39	100
Glasgow local bus	-	-	2	40.0	1	20.0	2	40.0	5	100
Haringey DaR	53	46.1	15	13.0	32	27.8	15	13.0	115	100
London local bus	3	25.0	3	25.0	3	25.0	3	25.0	12	100
Totals	66	28.2	41	17.5	72	30.8	55	23.5	234	100

Note: 13 respondents were not able to select a statement.

7.9 The figures for the Glasgow local bus service are very small and those for the London local bus are reduced because a high proportion of the users could not answer the question. The even spread for those London passengers who did answer, however, is at variance from all the other services. But then the other services also vary one from the other.

7.10 The Doncaster passengers are clearly deriving a benefit from making extra journeys and getting to places which were previously inaccessible to them. In contrast the Glasgow Dial-a-Ride users were using the service as a substitute for other modes to a much greater extent, though here too the 'extra journeys' dimension (statements 3 and 4) is also important. The greater substitution effect in Glasgow may well be a reflection of the sort of people who are using the service; that is very largely ambulant disabled who would have easier access to alternative modes than people confined to wheelchairs.

7.11 The Haringey Dial-a-Ride users show yet another variation in response. There the service is seen much more as a fall-back though a significant proportion find that they get out more than before. Judging by the comments made by the Haringey respondents when talking about the service, the problems of getting it, if resolved would probably reduce the fall-back response and increase the extra travel/different places response. However,

as the services operate at present the proportion of respondents getting out and travelling more runs:

Doncaster	82.5 per cent
Glasgow local bus	60.0 per cent
London local bus	50.0 per cent
Glasgow DaR	48.2 per cent
Haringey DaR	40.8 per cent.

7.12 Table 11 shows the same data disaggregated by whether or not the person uses a wheelchair. It is clear from this that the substitution effect is primarily felt by those people who can walk and that the extra travel (statements 3 and 4) more often accrues to people using wheelchairs. Thus almost 68 per cent of the wheelchair users regarded the services as giving them extra travel opportunities compared with some 44 per cent of the ambulant disabled.

Table 10

Responses to Statements on Value of Special Bus Services:

Ambulant Disabled and Wheelchair Users

Respondent category	Statement chosen: 1		2		3		4		Totals	
	No	%	No	%	No	%	No	%	No	%
Ambulant disabled	43	32.6	31	23.5	33	25.0	25	18.9	132	100
Wheelchair users	23	22.6	10	9.8	39	38.2	30	29.4	102	100

Note: 13 respondents were not able to select a statement.

Unsatisfied Demand

7.13 After the value statement question respondents were asked whether there were any particular travel needs which they were not able to satisfy at the moment. Although not asked with particular reference to the wheelchair accessible bus services, respondents tended to interpret it as concerning these services and to a considerable extent the replies repeated statements made in answer to the question on how the wheelchair accessible bus services could be improved. Thus the answers were largely concerned with getting access to other places or having a more frequent service. Where purposes rather than destinations were mentioned these were most often either medical or holiday and recreation. The responses to this question are summarised in Table 11 which distinguishes between wheelchair users and ambulant disabled. More of the former than the latter said that they had unfulfilled travel needs: 48 per cent versus 31 per cent.

Table 11 Unsatisfied Demand

Service	Wheelchair Users* Have unsatis. demand	No unsatis. demand	Ambulant Disabled Have unsatis. demand	No unsatis demand	Totals Have unsatis demand	No unsatis demand
Doncaster local bus	21	29	1	12	22	41
Glasgow DaR	1	2	7	29	8	31
Glasgow local bus	3	2	–	–	3	2
Haringey DaR	17	21	32	50	49	71
London local bus	10	2	2	3	12	5
All	52	56	42	94	94	150

*Excluding 3 wheelchair users of LBL's service who did not express an opinion

8. CONCLUSIONS

8.1 There can be little doubt about the value and importance to disabled people of providing the types of bus services discussed in this report. Overall these special services accounted for just over 31 per cent of all the respondents' journeys outside their homes. The actual use, measured in numbers of round trips per four weeks, varied from service to service, the range being from 2.3 to 8.7 trips in that period.

8.2 Obviously this level of use is dictated at least in part by the availability of the service. Measuring actual use against service availability shows that the Doncaster respondents achieved over 70 per cent of full utilisation, while the Glasgow DaR users (assuming one round trip per day of service as full utilisation) achieved 66 per cent.

8.3 The special services were also important in that they generally allowed access to a range of activities. They were particularly important for journeys to day centres, for shopping and for social purposes, but with the single exception of medical purpose trips at least 22 per cent of activity locations were visited using the special services.

8.4 Even with the use of these services, however, the data show that many disabled people are still at a mobility disadvantage in comparison with their able-bodied peer groups. The comparisons made suggest that their trip rate is only about 40 per cent of that of the more able-bodied. The background data on household structure, employment and car ownership suggests that the majority of the special bus users do not have the material resources to command alternative private transport and do, therefore, need a public based transport service.

8.5 Perhaps surprisingly the fixed route local bus services carried a higher proportion of wheelchair bound people than did the demand-responsive services. This difference largely explains why a higher proportion of the local bus users considered that their service gave them extra mobility rather than, as for the DaR users, providing a substitute for other modes or a fall-back in case of need.

8.6 A separate analysis of the users of the Doncaster service, with its high proportion of wheelchair passengers, showed that quite a lot of the users travelled some distance to get to the bus from their home. Only 35 per cent were within 100 yards of a bus stop, a further 44 per cent travelled between 100 and 400 yards and the remaining 21 per cent travelled from over 400 yards to (in two cases) over half a mile.

8.7 Obviously there is a value to some people in having the bus come to their door but for many it does not appear to be essential. The commonly used (in the UK) measure of reasonable access to a bus route of 400 yards appears to work for disabled as well as able-bodied people. There is, however, an important caveat to this. As was shown in Figure 1 the majority of people in wheelchair cannot go anywhere outside their home unless they are accompanied. So the criteria of distance to the bus is important if the wheelchair user does not have ready access to a relative or friend who will go out with them.

8.8 This study shows that for most of the respondents (about 85%) there was no difficulty in finding someone to accompany them. But, since the sample was drawn from bus users the arguement that most people do not have this problem is possibly, even probably, tautological. In the areas in which they operate, the specail service users only represent a tiny fraction of the area population. Even Haringey DaR, which has a substantial list of members, has less than 1% of the borough's population whereas national surveys suggest 2.5% of the population are unable to use buses because of physical problems.

8.9 Not all of this larger percentage would wish to use the services: some will have access to cars, some will be too ill even to go out at all, but even allowing for these factors the specail bus services are still only scratching the surface of disabled peoples' mobility needs.

8.10 The two types of service as described in this paper, fixed route and demand-responsive, appear to cater to some extent for different activities. The evidence from this study suggests that both have a role to play. To date most areas in Great Britain, if they have any service for disabled people, have one or the other not both. Strathclyde PTE has provided both initially expecting that by linking the two types of service they would allow disabled people to start from home on the DaR service and then transfer to the fixed route services if they wanted to go further afield, for example into the city centre. Practical experience showed that these transfers did not happen: the two types of service were very largely used separately. Evidence from this present study tends to reinforce the belief that the two types of service do have different roles and should be regarded as complementary to each other not as alternatives.

8.11 However, if joint fixed route and demand-responsive services are to be provided and are to be effective this implies a degree of control over and planning of how the services are operated, what purposes and what destinations they serve. It would make little sense to provide a fixed route service to the town centre or a major shopping centre and to permit a demand-responsive service to offer the same service. Each type of service has its strengths; each its weaknesses. Without co-ordination and all that that implies for organisation and control, neither can separately meet the needs of disabled people nor severally provide the level of service which disabled people have every right to expect. Given that resources for providing these services are limited care needs to be taken to ensure that the services are available to those who really need them. This applies particularly to demand-responsive services where vehicle and system capacities are limited. The relatively high proportion of the users of the Glasgow demand-responsive service who can and do use ordinary buses suggests that perhaps slightly more stringent eligibility criteria ought to be used if only to allow greater opportunities for use by people who have no option but to use the special services. Admittedly some 60 per cent of the Glasgow DaR passengers who also used ordinary buses had some difficulties in so doing: but by the same token 20 per cent of the people using the DaR service used ordinary buses as well without, apparently, any problems. Other studies have shown that by comparatively modest changes to the design of ordinary buses a substantial number of slightly disabled people would be able to use them without difficulty. What emerges then is a policy which:

(i) provides ordinary bus services with vehicles which can be used without difficulty by elderly and slightly disabled people;

(ii) provides co-ordinated services for people who are more severely disabled which both offer them a reasonable range of access to activities and make the best use of the strengths of the two sorts of service: demand-responsive and scheduled.

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THE NEED FOR PUBLIC TRANSPORT ACCESSIBLE TO THE DISABLED

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The need for public transport accessible to the disabled

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Hong Kong, a small territory of 400 sq. miles with a population of 5 1/2 million people first became aware of the problem of rehabilitating the handicapped when the Hong Kong Society for Rehabilitation was formed in 1959. Since then there has been a growing recognition of the rights of the disabled. Major areas of Hong Kong and Kowloon have dropped kerbs and bleeping signals for the blind at street junctions. New buildings must be accessible in accordance with the Code of Building Practice and employers are slowly beginning to realize the work potential of the handicapped. But the biggest problem yet to be solved is the establishment of a satisfactory means of transport.

Public transport, the Hong Kong scene

There are probably more double-decker passenger buses to the kilometer in Hong Kong than in any other city in the world to-day. In addition to these buses we have the Mass Transit Railway (MTR), i.e. our underground railway system with trains running every three minutes to 37 stations over a total distance of 38.6 kilometers, including the rail tunnel under the harbour. We are also served by a large fleet of 14-seater minibuses. Yet none of these means of transport is accessible to wheelchair users and other people with mobility problems. Indeed anyone who has visited Hong Kong and experienced its frenetic lifestyle will agree that even if one had only a minor handicap it would still be difficult to use these modes of transport. Even the ferries, much used by commuters, have limited accessibility.

Hence, in 1977 after a study of the transport needs of the disabled in Hong Kong a pilot scheme was undertaken to see if we could find an acceptable form of transport for the disabled. The idea was to use some form of minibus specially designed or adapted for use by disabled persons. The Joint Council for the Physically & Mentally Disabled, an organization of non-government voluntary rehabilitation agencies, was requested by the government to undertake the experiment. Two 7-seater minibuses equipped with tail lifts were borrowed for the project and after a year's trial it was obvious that there was a large demand for the service. As a consequence the Hong Kong government agreed to subsidise this service and the go-ahead was given to purchase some minibuses and have them adapted and put into use. The scheme was handed over to the Hong Kong Society for Rehabilitation and, following publicity, some minibuses were presented to us by business firms and the Jockey Club. We call these special minibuses REHABUS.

We now have a fleet of 21 twelve-seater Rehabuses running on 19 routes in Hong Kong and Kowloon. Passengers on the Rehabus must be physically disabled people who find it impossible or very difficult to take public transport. Included also are young mentally retarded females, and blind people pending completion of their training in independent living. These minibuses bring 228 handicapped passengers from their homes each morning to their place of employment or school or clinic as the case may be, and back again in the evening. The fare charged is HK$2 per trip which is about 40% of the flagfall charge in a taxi or twice the fare charged on the public buses. The same Rehabuses are used at week-ends for a dial-a-ride service which is specially suitable for handicapped people who wish to go to the beach, or to a meeting, or to take part in some entertainment. The Rehabus service is partially funded by the Social Welfare Department of the Hong Kong government.

There is a great demand for this service, so much so that there is currently a waiting list of about 130 and we cannot begin to meet this demand until we get more buses either from the government or from private donors. Even when a new Rehabus is donated we still have to obtain the government's agreement to subsidise the running cost (including the drivers' wages) because the fares collected can only meet 12% of the running costs.

Can this service be cost-effective ?

While this service, though inadequate, is good as far as it goes there are certain criticisms levelled at it chiefly on the grounds of cost-effectiveness, that favourite shibboleth of certain government departments. We are told that the buses are not used to the maximum. The criticisms focus on the fact that there is a period of a few hours in the middle of the day when the Rehabuses are not running. The reason for this is simple: the buses are used during the rush hours of the morning and evening, because, as we have stated, they are used by handicapped people as a necessary means of getting to and from work or school. That means that the Rehabus drivers have to start work at around 6.00 a.m. to make their rounds to the passengers' homes and are not finished until 9.30 a.m. or 10.00 a.m. A similar routine takes place in the afternoon when the drivers are on the road from about 4.30 p.m. to 7.00 p.m. or later. Our contract with our drivers is for an 8-hour day (and each day they have to travel from their homes to wherever the Rehabus is parked). If the Rehabus were to be in use all day we would need to employ 19 more drivers or, alternatively, pay our present drivers for overtime. This would obviously be less cost effective, apart from the fact that few disabled people would require regular transport during the middle of the day.

Evaluation by consultants

In order to meet with these and other criticisms of the Rehabus service, we employed a firm of consultants to make a thorough review of the Rehabus system and make recommendations for its future operation. The consultants summed up their review of the system in the following statement:-

> "The Rehabus system provides a useful service to a very limited number of disabled persons, but is deficient on three main points:
>
> 1. It fails to meet the demand for service.
> 2. It fails to cover its operating cost.
> 3. It provides an inferior level of service in terms of comfort and convenience."

The financial dilemma

The consultants are currently undertaking a thorough re-scheduling exercise, but though this may bring about some improvements in regard to the points just mentioned, it will not provide a solution. The Report says "There can be no possibility of the existing operation covering its operating costs while charges for the use of the service remain at present levels in accordance with the declared policy of users being provided with a service at charges comparable to normal public transport fares".

The Report also draws the fairly obvious conclusion that the only way to catch up with the long waiting list is to increase the Rehabus fleet. Comfort and convenience can only be attained by using better buses.

It will not be difficult to see that all this comes back to the problem of financing the project. It seems that if it is run by a voluntary body relying upon government support it will never be self-supporting. Can it? - Should it? - be run as a commercially viable operation? For this to be feasible there are certain necessary requirements. Its essential service would still be to bring the disabled to and from work or school during peak hours but the product must also be of a nature for which an off-peak demand is likely to apply. This concept almost automatically eliminates the use of buses, whether large or small, because there is very limited demand for Rehabuses in off-peak hours in addition to what is at present available. Hence Rehabuses put on the road during off-peak hours would be under-utilized and hence still less cost effective.

It will be apparent from the Report that the Rehabus, while meeting a need to a limited degree, is not the complete answer to the problem. Frankly I believe personally that we will never bring freedom of movement at a reasonable cost to the disabled in our community until all public transport is accessible. In Hong Kong, as of now, with our crowded double-decker buses riding on steel springs and our Mass Transport Railway designed only for the able-bodied, our public transport has a long way to go before it will cater for the travelling needs of the disabled. Not for us the kneeling bus with the lift for wheelchairs which one sees in North America and in some European countries. Double-decker buses riding on springs cannot do this. So what is the solution?

A solution ?

An interesting solution to this dilemma has been suggested by our consultants: the use of converted London taxis. There is a firm in England which has re-designed the traditional London taxicab so that it can take a person seated in a wheelchair together with four other passengers, disabled or otherwise. The proposal is to use these converted London taxis in Hong Kong in the following way: during the morning and evening rush hour they would take disabled people from their home to work or to school and back again in the same manner and at the same fare as the existing Rehabus service. The difference would be that these London Taxis (run by a taxi company) would be free during the middle of the day and in the late evening to ply for hire in the same way, and for the same metered fare, as ordinary taxis. In this way it is hoped that what the taxi would earn in off-peak hours would balance out the losses incurred by the cheap fares charged to disabled passengers during the rush hours. They could be awarded a special franchise to serve the airport. There would, of course, be tax and licence incentives to encourage participation in the scheme. We are arranging to have one of these London taxicabs in use in Hong Kong in the near future for a trial period.

An alternative plan

Consideration is being given also to another plan, to use seven seater sedan-type maxi-taxis adapted to take wheelchair users. These would be equipped with radio communication and would operate on similar lines to those used in New Zealand for their Total Mobility Program which is apparently working very successfully after a short trial period.

In regard to both these projects, the London Taxi and the Maxi-taxi service, it is obvious that many problems still remain to be solved, e.g. how will this service be monitered? Should it be run by a voluntary organization or by an already established taxi company? How will the difference in fare be rationalized and how will the time allotted for reduced fares be established and controlled ?

Combining public transport with special service ?

In Hong Kong, apart from the double-decker buses and the Mass Transit Railway there is a large fleet of 14-seater Public Light Buses (PLB for short) operating over all the territory on a commercial basis. The Association of PLB owners some years ago voluntarily offered priority and reduced fare to handicapped and elderly passengers. If the PLB owners could go a step further and equip at least a portion of their minibuses with tail lifts to take wheelchairs we might begin to solve our problem. We would have a useful form of public transport which would provide service to places outside the range or the demands of the Rehabus, and being a form of public transport would solve another problem, integration of the handicapped with the rest of the community.

IMPLEMENTING A MULTIMODAL APPROACH TO TRANSPORTATION OF ELDERLY AND HANDICAPPED PERSONS

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On January 19, 1985, the residents of the City of Austin, Texas, voted to approve the implementation of Capital Metropolitan Transportation Authority (Capital Metro). Embarking on a new option for transportation in the Austin metropolitan area, Capital Metro implemented a very ambitious program of expansion on July 1, 1985. After one year of operation, Capital Metro is well on its way to becoming one of the largest transit systems for a city its size in the United States, going from an 80-bus peak fleet to a 200-bus peak fleet in little more than one year. Buildout in three years is anticipated to include over 350 buses during peak hours.

One of the foremost objectives of Capital Metro was to build a transit system that could be effectively utilized by elderly and disabled persons. To this end the Mobility Impaired Service Advisory Committee (MISAC) was formed. In May 1986 MISAC came out with its recommendations for serving the mobility impaired.

At about the same time the U.S. Department of Transportation (DOT) came out with its long-awaited Section 504 Final Rules.[1] Capital Metro now has the opportunity to be one of the first transit systems in the country to implement its initial policy for serving the mobility impaired based on the Final Rules of Section 504. Capital Metro will be in the unique position of being in the process of building its system while implementing the regulations.

Section 504

The final Section 504 rules as they pertain to mass transit have changed little from the proposed rules issued in 1983. The rules state that each locality may choose the type of service used to meet community needs. A transit system which receives federal assistance shall meet the service criteria spelled out below as soon as is reasonably feasible but no later than six years after the initial determination by UMTA concerning approval of its program.

The criteria for special service (paratransit)[2] are as follows:

1. Eligiblity. All persons who by reason of handicap are physically unable to use the bus service for the general public shall be eligible to use special service.

2. Response Time. Service is to be provided to a handicapped person who requests it within 24 hours of the request.

3. <u>Trip Purpose Restrictions</u>. Restriction or priority based on trip purpose is prohibited.

4. <u>Fares</u>. The fare for a special service system shall be comparable to the fare charged to a user of the bus service for the general public for a similar trip.

5. <u>Hours and Days of Service</u>. Special service hours and days shall be equivalent to those for bus service for the general public.

6. <u>Service Area</u>. The special service shall be available throughout the circumferential service area in which the transit system provides bus service to the general public as well as to points outside this area served by express or commuter bus.

The criteria for accessible bus service are as follows:

1. <u>Hours and Days of Service</u>. Scheduled service shall be available throughout the same hours and days as service for the general public. The service shall be provided at reasonable intervals which make practicable the ready use of the service by the handicapped.

2. <u>Service Area</u>. Accessible service shall be provided on all bus routes on which a need for this service has been established through the planning and public participation process.

3. <u>Fares</u>. Fares shall be no higher than for other passengers. Reduced off-peak fares for elderly and disabled persons shall be in effect.

The criteria for on-call accessible bus service are as follows:

1. <u>Eligibility</u>. All persons who by reason of handicap are physically unable to use the general public bus service.

2. <u>Response Time</u>. This is to be within 24 hours of the request.

3. <u>Restrictions</u>. These shall be no priorities or restrictions based on trip purpose.

4. <u>Fares</u>. These shall be no higher than for other passengers. Reduced off-peak fares shall be in effect.

5. <u>Hours and Days of Service</u>. Available throughout the same days and hours as service for the general public.

6. <u>Service Area</u>. Available on any bus route upon request.

The criteria for a mixed system include the criteria for both special service and accessible bus service, with the stipulation that both services be coordinated.

The public participation process includes:

1. The transit system shall consult during the planning process with disabled persons and organizations representing them, concerned public officials, and the Metropolitan Planning Organization. During this process all cost estimates, plans, working papers, and other information pertaining to the transit system's program planning shall be made available to interested persons.

2. A public comment period of at least 60 days is required. At least one public hearing is required.

3. A response to public comment is required no later than the time a program for transmittal to UMTA is adopted.

4. The transit system shall provide a mechanism for continuing public participation in the development and operation of its system of transportation of the disabled and prior to making any significant changes.

The limit on required expenditures for a fiscal year is 3% of the total annual average operating costs which the transit system expects to incur in the current fiscal year and did incur during the two previous fiscal years. However, the transit system is not required to spend more than its limit in order to comply even if as a result the system cannot provide service to handicapped persons who fully meet the service criteria. Each transit system must always meet the eligibility criteria, however.

Development of Capital Metro's Recommendation

Shortly after the implementation of Capital Metro on July 1, 1985, the Mobility Impaired Service Advisory Committee (MISAC) was formed. Because Austin had a long history of public involvement in delivering services to disabled persons (including implementation of a paratransit system in 1976), this service was determined by the Board of Directors to be a priority.

MISAC, which started in August 1985, is made up of 30 members and their alternates. The staff has made efforts to include individuals and representatives from the widest range of disabled organizations possible. These include: individual users from the visually impaired, wheelchair-user, and elderly community. Representatives from National Federation for the Blind, American Federation for the Blind, American Disabled for Accessible Public Transportation (ADAPT), Mobility Impaired

Grappling Hurdles Together (MIGHT) (a local cross-disabilities organization), Association for Retarded Citizens, United Action for the Elderly, and other organizations representing disabled persons. This wide mix of individuals and organizations represents a wide range of disabilities, including some which are not included in Section 504 regulations (mentally retarded and elderly persons).

This diverse group of consumers and advocates has naturally developed into a wide range of political positions and opinions as to what type of service meets the needs of the community. Groups such as ADAPT and other advocates for disabled persons are strongly in favor of 100% wheelchair accessibility onto fixed-route buses. The basic arguments of this group is based upon civil rights and moral principles. Their feeling is that paratransit is separate but unequal. They liken their position to that of black activists prior to the 1964 civil rights legislation, except in this case they can't even get on the bus, let alone ride in the back.

From the perspective of a tax-paying wheelchair user, it is unconscionable to be living in a country where billions of dollars are spent to support public transit systems and having little or no access to that system.

Other organizations and individuals representing mentally retarded, blind, frail elderly, and other disabled persons advocate for an expanded role for paratransit, arguing that many disabled people cannot get to a bus stop to catch a bus, and putting lifts on buses would no nothing to serve them.

Many feel that the argument comes down to one of accessibility versus mobility. Certainly both sides of this argument have merit. No one mode will satisfy the needs of the disabled community. Many of the representatives of MISAC recognized that. The final Section 504 regulations recognized this as well, in allowing for a combination of the two modes.

> "It is staff's position that there is at least some merit to both discussions from a political and moral standpoint. The recommendations herein reflect that perspective. However, it is not within our jurisdiction to determine or define the civil rights of persons with disabilities. Congress, the courts, and UMTA have made those definitions for us, and Capital Metro is well within the scope of responsible and reasonable accommodation."[3]

It is clear that a mix of service is best suited to meet the needs and expectations of all sides concerned. Either a pure paratransit or pure linehaul approach would leave some people disenfranchised. The next question is how much of each mode is sufficient to meet the needs without providing redundant service and spending more than necessary to do the job.

Staff's recommendations were based on an exhaustive study, taking into consideration user needs, political concerns, and financial implications. Those recommendations are as follows:

> Staff recommends a mix of services to serve the needs of persons with mobility impairments and elderly. That mix should include:

1. Linehaul accessibility: A sufficient portion of Capital Metro's linehaul fleet should be lift equipped to provide a headway of at least 30-minute service on routes going to the CBD. This will translate into a lift ratio of roughly 50% of the peak fleet. Local and feeder routes are not a priority for lift equipment. Accessible express buses and park-and-ride buses should be available to provide lift vehicle assignment on a passenger request basis. Suburban interior transit coaches should be deployed for the express and park-and-ride services, and Capital Metro should not purchase accessible over-the-road coaches.

2. All special-purpose vehicles, e.g., the 'Dillo route, and special event shuttles, should be 100% lift equipped.

3. Special transit services should be expanded to provide same-day-response capabilities. This may require a zoned transit system in some outer areas and transfers to the line system for requests of 3 hours or less. The fleet requirement is projected to be 30 vehicles at buildout. Service will include a voucher system in some areas. All paratransit vehicles should be lift equipped.[4]

As expected, MISAC was divided on this issue. However, one organization which represented the widest range of persons with disabilities lobbied very hard for the mixed approach and, with minor modifications, MISAC passed the recommendation by a vote of 15 to 2. The majority vote included some staunch advocates of 100% accessibility.

The Plan - Short-Term

Currently Capital Metro has a 14-bus peak paratransit fleet called Special Transit Services (STS). In addition, a contract with a taxi company provides back-up to the service. The service allows for confirmed trips with 24 hours' notice and will accept requests with as little as 3 hours' advance notice

(95% of the requests are accepted). The service provides approximately 60% of its service for work-related trips, 15% to school, 15% to medical appointments, and 10% for recreational/shopping. The service currently meets the new Section 504 regulations regarding criteria for special service.

In the Fall of 1986, Capital Metro has plans to begin serving elderly persons. Currently the only elderly served are those who can also be termed disabled. The plan to serve the elderly is a twofold plan. The first part is to implement a "senior shuttle." This shuttle will utilize 30-foot, low-floor buses on a fixed schedule. The shuttle will circulate through neighborhoods with high concentrations of elderly persons and make designated stops at designated times at shopping, recreational, and medical sites. One neighborhood will be circulated through at a time, with perhaps two to three neighborhoods per day. Depending on demand, a neighborhood can be served from once every two weeks to two or three times a week. If the demand continues to build in particular neighborhoods, a fixed route could be spawned.

The second component of the plan to serve elderly persons is to expand STS service to meet more of the individual needs of elderly persons which are not covered by the senior shuttle.

In addition, on July 27, 1986, Capital Metro will implement its second round of fixed-route service expansion by putting 80 new fixed-route buses and 20 new "suburban" type buses in service. All 100 of these buses will be lift equipped. This will supplement the 30 lift-equipped linehaul buses currently in service. When the new service is placed on the street, Capital Metro will have approximately 50% peak bus accessibility. Peak headway will be 15 minutes and off-peak headway will be 30 minutes. The service plan to be implemented will call for 30-minute headway for all buses going into the downtown area (over 90% of the service) during all service hours, making off-peak service almost 100% accessible. This will exceed the Section 504 requirements for accessible service.

Capital Metro also provides a downtown circulator service called the Armadillo Express ('Dillo). This service utilizes a trolley style bus which has two routes circulating in downtown, the state capitol complex, the University of Texas, and Austin Community College, connecting to a parking facility just outside the downtown area. This service is very popular and convenient for those individuals who work or go to school in the above areas. Currently approximately one-half of these buses are lift equipped. The majority of the lift-equipped service is on one route going through downtown and serving the Austin Community College campus. This service also meets the Section 504 requirements as a stand-alone service. However, the staff recommendation is to make this service eventually 100% lift equipped.

The final component of Capital Metro service is the park-and-ride service. Most of this service is provided in over-the-road coaches, with some of it to be provided with the accessible "suburban" coaches. Current plans are to equip some routes with suburbans. Staff has recommended that over-the-road coaches not be equipped with lifts, based on the following: (1) there are no proven reliable lift-equipped over-the-road coaches in service; (2) the lift and supporting mechanism would occupy approximately 10% of the seating capacity; and (3) the demand, which is low, can be met by either on-call suburbans or special transit.

In addition to this service, an experiment in the timed-transfer concept is to be implemented in several locations. Feeder neighborhood routes and express buses will arrive at a timed-transfer terminal at the same time. Within 5 minutes the buses will leave again, heading out to circulate the neighborhoods or head downtown. This will facilitate the transfer of individuals, cutting down on the "pain and agony" of transferring. It is also planned that STS buses circulating neighborhoods will be able to feed into the terminals and transfer passengers to and from express buses, initially serving disabled passengers but eventually providing feeder service for all passengers at night, weekends, and other low demand times.

This ambitious plan is to be implemented on July 27, 1986, with fine tuning in the fall and a smaller scale expansion in January 1987. This smaller expansion will include the addition of 20 to 30 transit coaches, all with lifts.

The Plan - Long-Term

Staff's current long-term plan includes a continued expansion of the coordinated multimodal approach that is currently under way. STS resources will be increased to provide one-hour response time in order to serve mobility impaired persons with the same options of making spontaneous travel decisions as other sectors of the general population have. The STS service will be opened up to the entire general population in outlying areas where fixed-route buses do not serve and on nights and weekend low ridership periods when paratransit can replace fixed-route service economically.

However, there will be some trade-offs. In order to implement this expanded role for STS, in effect "mainstreaming" paratransit, transferring to and from fixed-route, paratransit, and other modes will be required. The proposed timed-transfer concept will facilitate this transfer. Paratransit vehicles will meet at timed-transfer points throughout the city just like fixed-route buses. Disabled individuals will be provided an appropriate level of assistance in order to transfer. At

the point of destination (if needed), another vehicle will meet with the fixed-route bus to conclude the disabled person's trip.

Fifty percent of the fixed-route peak fleet and one hundred percent of the off-peak fleet will be lift equipped. There would not be a need for further lift equipment on the fleet due to the coordination of paratransit. It is anticipated that due to this coordination, wheelchair user ridership on fixed-route buses will be enhanced considerably.

Travel into the downtown area will be facilitated with 100% accessible downtown circulation service ('Dillo), as well as with paratransit vehicles.

This ambitious plan that is currently being proposed will take a broad commitment from staff, the Board of Directors, as well as from MISAC and all passengers. Section 504 gives us the flexibility to meet the needs of the entire disabled community. This will enable Capital Metro to continue to do its part in serving the elderly and disabled persons in its service area.

Mainstreaming the entire system, both fixed-route and paratransit, is a concept whose time has come in Austin. With the full commitment of all involved, this concept will work, meeting the transportation needs as well as the philosophical needs of disabled persons in the community.

Footnotes

[1]Section 504 of the Rehabilitation Act of 1973. 49 CFR Part 27. Nondiscrimination on the Basis of Handicap in Financial Assistance Programs; Final Rules.

[2]"Special service system" is defined as a transportation system specifically designed to serve the needs of persons who, by reason of handicap, are unable to use mass transit systems designed for the use of the general public. This definition encompasses a wide variety of ways of providing service. The second sentence of the definition is intended to identify the typical characteristics of a special service system.

[3]Capital Metropolitan Transportation Authority. Draft Report and Service Plan for Public Transportation for Mobility Impaired Persons. March 1986.

[4]Ibid.

ACCESSIBLE COMMUTER RAIL
FOR THE DISABLED:
AN EVALUATION AND DECISION MAKING FRAMEWORK

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ACCESSIBLE COMMUTER RAIL FOR THE DISABLED: AN EVALUATION AND DECISION MAKING FRAMEWORK

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INTRODUCTION

Those charged with planning commuter-oriented transportation investments often find life to be "just one damn thing after another". But whatever other troubles these planners have, they do not lack for technical advice on how to choose among competing alternatives. Numerous texts present the theory and practice of cost-benefit analysis, goal-programming and other techniques, and public agencies now apply them routinely. Virtually absent from these techniques, however, are systematic ways of integrating the requirements of disabled persons into the mainstream calculus of transportation planning.

This state of affairs is important for two reasons. First, the disabled are distinctly lacking in characteristics that set their transportation problems apart from those of other members of the general public. Many live in the suburbs, miles away from concentrations of employment, schooling and other economic activities. In failing to address their commuting needs, transportation planning dampens the potential economic contribution of the disabled to a nation's gross national product. Second, government at all levels is concerned with the distributional consequences of its investments -- the sense that benefits and costs are shared equally. As taxpayers, the disabled help finance public transportation investments, but they share unequally in the benefits of such investments where planning techniques fail to incorporate their needs. In response to these concerns, this paper presents the results of a study designed to extend the traditional transportation planning apparatus with a methodological approach and decision framework for evaluating alternative commuter-oriented transport services for disabled persons. The primary focus of the study is the operational feasibility, economic viability and effectiveness of making commuter rail services accessible to disabled persons.[1]

The question of alternative commuter-oriented transport improvements for disabled persons is a source of great controversy. Those speaking on behalf of certain representative groups of disabled persons maintain that special door-to-door services are discriminatory and that the human rights legislation protects them against such discrimination by guaranteeing their right to use the same publically financed services available to everyone else. Other disabled persons argue that separate door-to-door services are permissable, but only if they offer a standard of convenience "equal" or comparable to that of public transit. Some believe that this calls for a partially integrated approach whereby key routes of the conventional commuter rail system are made accessible while feeder services extend the service from door-to-door.

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1. The study is to be published by the Transportation Development Centre of Transport Canada later this year.

KEY UNCERTAINTIES

The costs and benefits of these alternatives are the subject of this paper. However, there are important uncertainties standing between expected outcomes associated with the options and the real results. The key technical and economic uncertainties facing the choice between accessible commuter rail (with feeder service) and separate door-to-door service are:

MAJOR UNCERTAINTIES

- o Will the extra time needed by wheelchair users to board commuter rail trains via lifts and ramps slow down schedules to the point where existing passengers abandon the system or where the schedule fails to be operational?

- o What is the cost associated with alternative levels of door-to-door service, in particular the expense of reducing the time passengers must book ahead for service?

Together with technological uncertainty in the choice of lifts and other wheelchair boarding technologies and the chance of cost overruns, the above are the operational and economic risks with which social and institutional uncertaintly must also be combined.

The key social and institutional uncertainty revolves around demand forecasts, travel habits being a reflection of nothing less than our role in society generally. Each approach to the travel needs of disabled persons has its unique cost characteristics but all are closely linked to projected patronage. The cost of adapting commuter rail systems and facilities is broadly fixed, regardless of the use made of them by disabled persons. The cost of door-to-door transportation, on the other hand, is relatively flexible; it depends heavily on the number of handicapped persons who use it. This means that, below a certain level of demand, plans that emphasize door-to-door services will cost less than plans requiring adaptations in commuter rail systems. Cost-per-trip (a measure of effectiveness) displays a similar profile. Beyond a certain level of patronage, accessible commuter rail systems would appear more cost-effective then door-to-door service since cost-per-trip of adapted transit declines sharply as more people use it. Cost per trip of door-to-door service, on the other hand, is relatively stable, regardless of patronage.

The analytic challenge stems from the fact that as a society we are striving hard to improve the role of disabled persons in society. This makes demand estimates the most critical element in the investment appraisal and yet the most uncertain. "Most likely" projections of demand, those based on the best available analysis of past travel behavior of disabled persons, offer the most probable near-to-medium terms results of a given investment. They fail, however, to reflect the potential long term social and institutional changes in society that could sharply alter the travel opportunities and patterns of the disabled. For example, surveys indicate that disabled persons travel only half as often as the able-bodied, largely because of their chronically low rate of employment (generally in the range of 20 percent of working-age

disabled persons versus 60 percent among the able-bodied of working-age). As employment among the disabled grows in response to government program initiatives, to medical advances that create further opportunities for independent living and to shifts in attitudes generally, their propensity to travel will grow disproportionally to that of the population generally.

APPRAISAL METHODOLOGY: A SCENARIO APPROACH

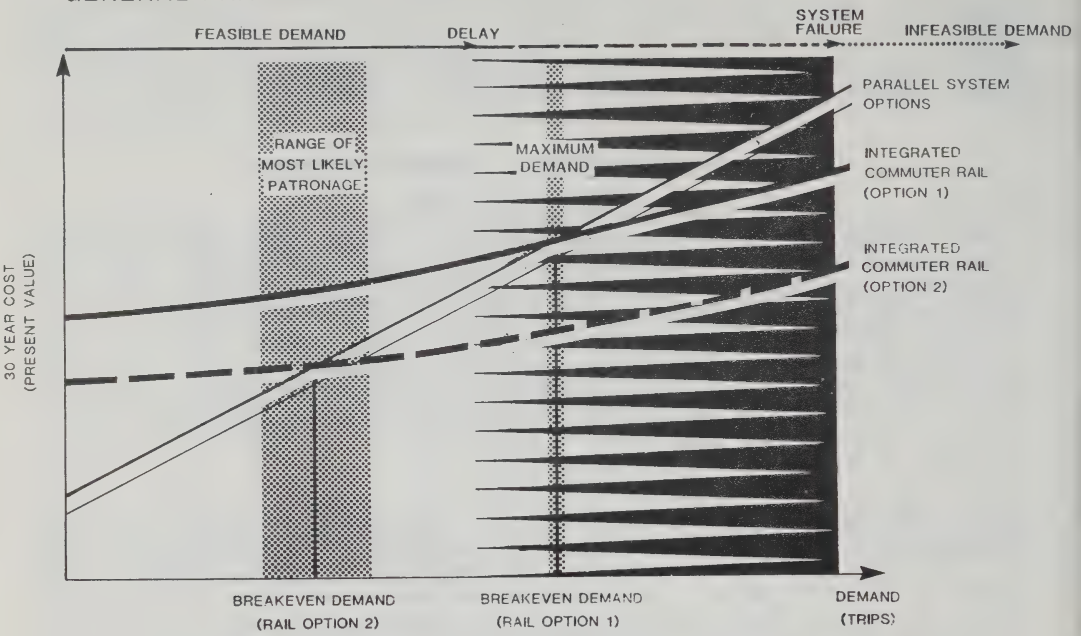
In view of the importance and uncertainty associated with forecasting the actual volume of disabled passenger-trips, we have developed a scenario framework designed to reflect a probability range of forecast demand and associated cost and operational impacts (Figure 1). The problem at hand is to appraise the cost and effectiveness of making commuter rail accessible to the disabled (with lifts, elevators and ramps and feeder service) relative to the cost and effectiveness of providing door-to-door specialized public transport. First, the range of most likely demand (see Figure 1) depicts the potential near-to-medium term volume of disabled passenger trips. The forecast can be based on actual demand rates observed in accessible systems, suitably adjusted for any special factors in the system under study.

The second demand forecast developed under the evaluation framework, termed maximum conceivable demand (see Figure 1), represents a "scenario" -- or "what if" forecast. Under this approach, the major barriers that inhibit travel among the disabled today -- particularly low employment rates -- are assumed to be largely eradicated and their use of accessible bus or rail systems is assumed to approach that of the public generally. (Their use of such systems will still not equal that of able-bodied persons since the elderly represent a larger proportion of the disabled population -- about half -- than the representation of elderly persons in the population generally -- about a tenth. Elderly persons naturally travel less frequently, regardless of disability.) This forecast reflects long-term policy goals but obviously carries a lower (subjective) probability of occurance.

This approach is designed to allow the decision-maker to be fully aware of the degree of risk and uncertainty in the approach he decides to adopt, including any intangible qualities associated with the alternative approaches. The forecast range of most likely demand indicates the most probable operational and economic outcome while the maximum conceivable scenario depicts a much lower probability, long-term result. For example, the range of most likely demand might lie within the operationally feasible range but beneath the breakeven level, indicating that accessible commuter rail is technically feasible but not economic or effective relative to other approaches. The maximum conceivable demand, on the other hand might lie above the breakeven level (and within the feasible range). In this case, the decision framework would expose the kind of risks and rewards associated with a decision to proceed with an investment in accessible commuter rail -- e.g., little risk of operational problems, high risk of a relatively poor economic return in the foreseeable future and a small chance of a favourable economic return in the longer-term. The decision maker might be willing to take this economic risk in exchange for the change -- albeit a low one -- of a higher return in the future and the associated social benefits of mainstream integrated services for the disabled. Under this decision framework, however, he does so in full knowledge of the potential risks and their general probability.

FIGURE 1

GENERAL FRAMEWORK FOR EVALUATING TOTAL COST



GENERAL FRAMEWORK FOR EVALUATING COST EFFECTIVENESS

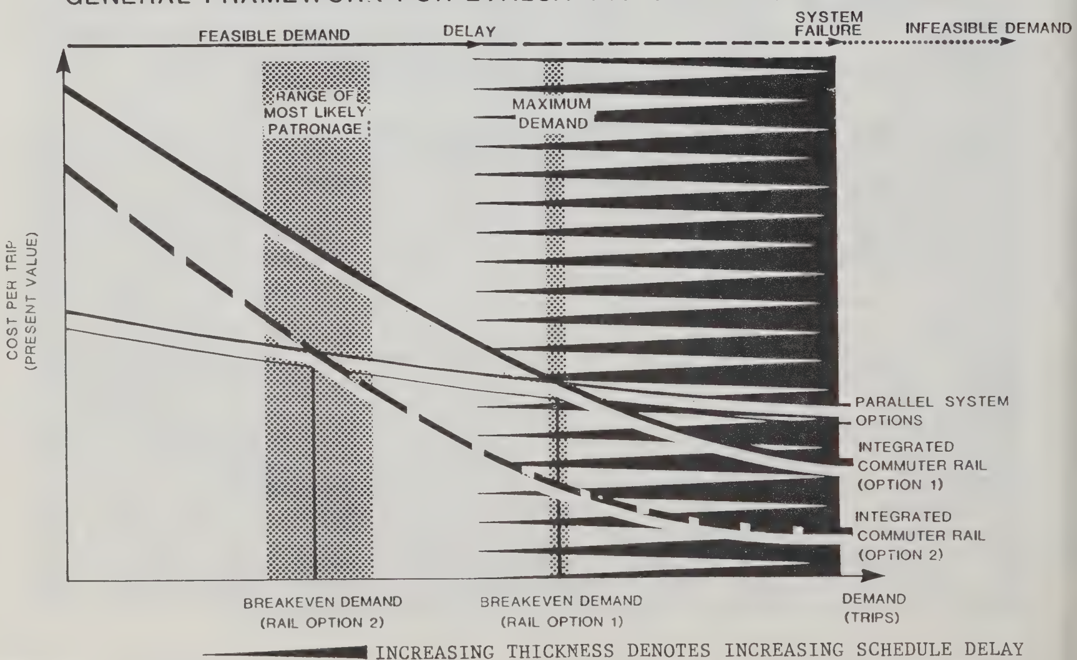


FIGURE 1: PAGE 2

DEFINITION OF TERMS

ECONOMY - TOP CHART

PARALLEL SYSTEM AND COMMUTER RAIL OPTIONS. Cost of alternative approaches and associated levels of service. Indicates comparative costs for alternative levels of service.

30 YEAR COST - PRESENT VALUE. Cash outlays for capital expenditures plus incremental operating costs for each option over 30 years, recalculated to reflect their present day dollar value. This allows direct comparison of options with different phase-in periods and life-cycle cost profiles.

FEASIBLE DEMAND RANGE. Volume of disabled passenger-trips by commuter rail that will not inhibit viable operation of commuter rail service. Indicates the level of patronage that can be accommodated either without causing delay in scheduled journey time or with progressively increasing delay until the system fails to be operationally viable ("system failure").

INFEASIBLE DEMAND RANGE. Volume of disabled passenger-trips by commuter rail that will inhibit viable operation of commuter rail system. (A viable operation is one that meets the range of most likely patronage without incurring unacceptable delay.)

RANGE OF MOST LIKELY PATRONAGE. Volume of rail passenger-trips by disabled persons most likely to occur in the short to medium term. Indicates whether likely patronage lies in feasible range. Also indicates most likely 30 year costs for commuter rail option relative to parallel approaches.

MAXIMUM CONCEIVABLE DEMAND. Long term, most optimistic volume of rail passenger-trips by disabled persons in a barrier free society. Indicates whether rail options are feasible under most optimistic rail patronage. Also indicates most favourable possible comparative cost for commuter rail option relative to parallel approaches.

BREAKEVEN DEMAND. Volume of rail passenger-trips by disabled persons above which total cost of commuter rail is less than that of alternative approaches. Should be assessed in comparison with likely demand.

EFFECTIVENESS - BOTTOM CHART

COST PER TRIP - PRESENT VALUE. Cash outlays on capital expenditures plus incremental operating costs over 30 years, recalculated to reflect their present day value, divided by total passenger trips over 30 years.

BREAKEVEN DEMAND. As above, for cost per-trip.

Another example would be a case where the likely demand occurs in the feasible range, but maximum demand occurs in the operationally infeasible range. Here the decision-maker is confronted with an additional element of chance if he chooses the accessible commuter rail approach. For not only does he risk a poor economic return because of low demand but he also takes the chance that accessible commuter rail operations will be severely disrupted if higher demand actually materializes. Perhaps his answer to this is the assertion that "roses do not come without thorns", a judgement based on certain intangible qualities he attaches to accessible rails. Again, however, the decision framework has revealed the risks so that policy decisions can be made with full information and disclosure; such is the role of decision analysis.

EVALUATION FRAMEWORK IN APPLICATION

Using two commuter rail lines, one in Toronto and one in Montreal,[2] the case studies below compare the investment alternatives in terms of three factors,

1. <u>Operational Feasibility of Accessible Commuter Rail</u>

    o Whether, at the projected demand for accessible commuter rail service, train schedules would be delayed; and, if so, whether disruption would be severe enough to make accessible commuter rail be operationally infeasible;

2. <u>Economy of Accessible Commuter Rail</u>

    o Whether, at the project demand for accessible commuter rail service, 30-year life-cycle cost is likely to be below that associated with alternative parallel alternatives; and

3. <u>Effectiveness of Accessible Commuter Rail</u>

    o Whether, at the projected demand for accessible commuter rail service, the cost-per-trip over a 30 year period is likely to be below that of alternative, parallel alternatives.

OPERATIONAL FEASIBILITY

Under the range of most likely demand, making commuter rail services accessible to the disabled would be operationally feasible. However, some delay to existing passengers appears inevitable unless only end-stations (or major terminal stations) are made accessible. With a small number of accessible intermediate stations, delay in peak journey time would range up to an estimated ten percent, and could mean a decrease in the number of trains and a loss in ridership.

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2. The two cases reported here are useful in demonstrating the use of the methodology outlined in Section 3.0. The analysis is not intended to represent a feasibility analysis for the lines in question and should not be represented as such.

The above conclusions are drawn from the case study results summarized in the graphic framework of Figures 2, 3, 4 and 5. In Figure 2 (Lakeshore West Line, Toronto), for example, a delay in journey time can only be avoided if accessibility is restricted to the end stations under study (see left-hand portion of the chart). With accessible intermediate stations as well, a delay of about 10 percent in the average peak journey is likely if disabled passenger-trips lie within the most likely range. This would add about four minutes to the currently scheduled 37 minute journey time along the line, between terminal stations. Such a delay would result in an estimated two-to-four percent reduction in existing passenger-trips (and railway revenues) -- a loss of between 400 and 800 passenger-trips a day versus a gain of 40 to 70 new disabled passenger-trips.

These results are consistent with those displayed in Figure 3 (Rigaud Line, Montreal). With two accessible intermediate stations, delays of about seven percent in the average peak journey would be probable if the most likely volume of disabled passenger-trips occurs. This would result in a loss of some 80 to 160 existing daily passenger trips versus a gain of 14 to 22 existing daily passenger trips per day. Such delays could be minimized if the most tightly scheduled peak trains (the two or three with the smallest gap [say 5 to 7 minutes] in their scheduled arrival time) were not to accept disabled passengers. This would permit operation close to existing schedules. Under these conditions, passenger and revenue losses in response to poorer journey time would run beneath one percent.

Under the maximum conceivable demand, delays could grow to an operationally very damaging level (up to 19 percent increase in journey time) unless only end-stations or terminals are accessible during peak periods. On the one hand, the probability of ever approaching this level of demand in the near-to-medium term is remote. Thus it could be argued that commuter rail operators would have time to adjust gradually to the operational shifts needed to accommodate the higher demand. Such gradualism would be critical since institutional changes -- such as those involving contractual agreements with freight railroads and passenger schedules -- would need to occur.

On the other hand, it is quite possible that a reduction of fully one-fifth in current schedules would change the very character of commuter rail, substantially dampening the public's perception of it as high speed mass transportation and causing substantial shifts to auto and increased road congestion. These conclusions are apparent in Figure 2. With only three intermediate stations being adapted for disabled persons, maximum conceivable demand on the Lakeshore Line would cause a journey time delay of an estimated nineteen percent -- fatal, insasmuch as 800 to 1,500 daily passengers would likely desert the service and freight train operations are likely to be substantially disrupted. Attracting the maximum conceivable demand with two end stations would minimize delay. In reality, though, this would be improbable with only two accessible stations since feeder journeys would be so long and arduous.

Similarly, in the case of the Rigaud Line, Montreal maximum demand would result in a 16 percent journey time delay, with operational problems leading to a drop of some 300 existing daily trips in order to serve about 100 new disabled passenger trips.

FIGURE 2 | TOTAL COST OVER 30 YEARS LAKESHORE WEST LINE: TORONTO

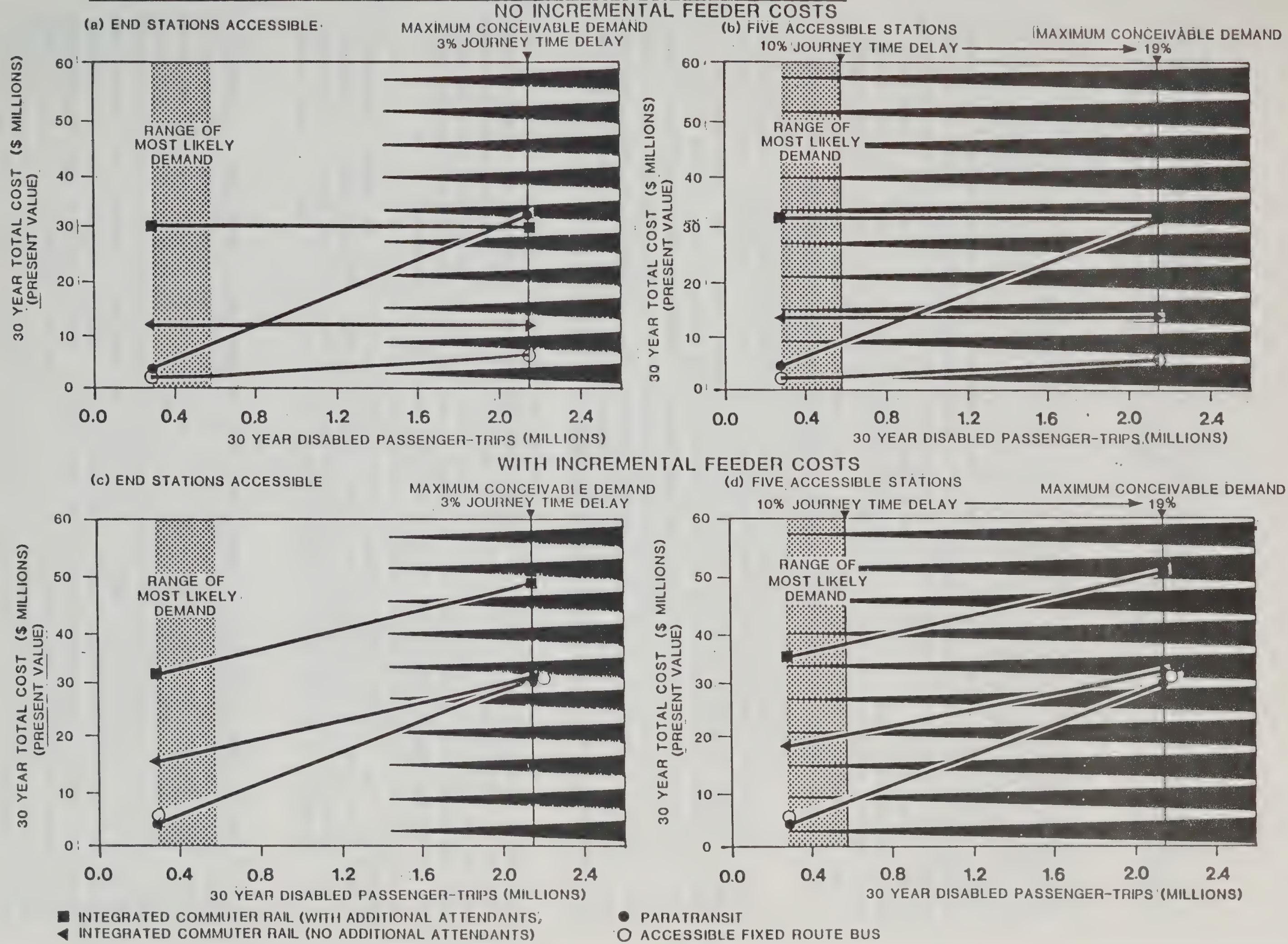
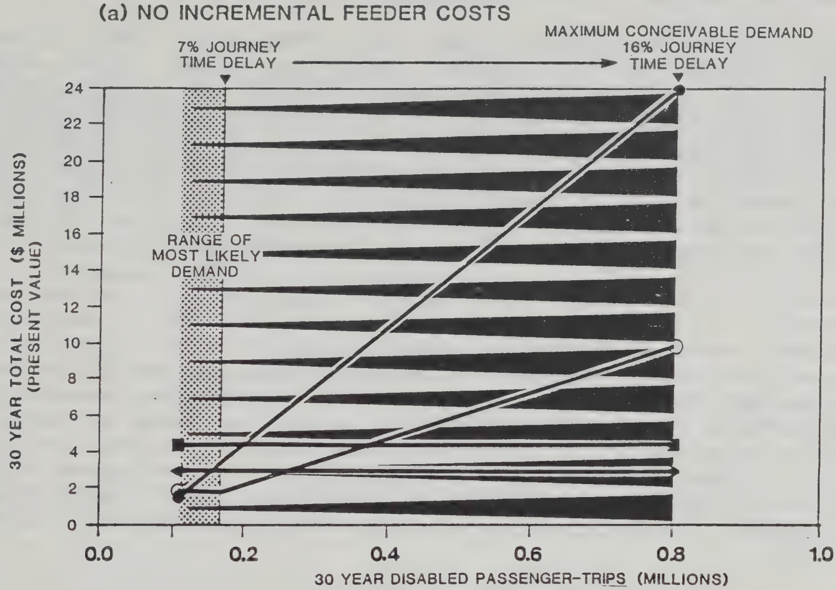
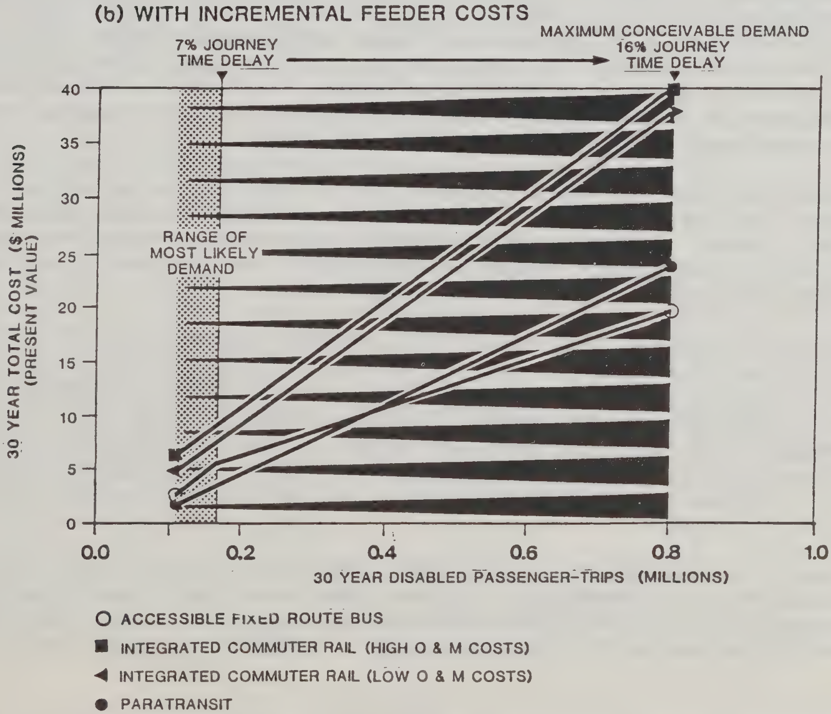


FIGURE 3 TOTAL COST OVER 30 YEARS
RIGAUD LINE, MONTREAL
(FOUR ACCESSIBLE STATIONS)





If key operational assumptions underlying the minimum cost solution are revised to reflect management policies, the feasibility of making anything other than terminal stations accessible may prove to be remote.

In the case of the Lakeshore West Line, Toronto, for example, management policy decrees that no schedule delay can result from accessibility improvements. Analysis indicates that at stations where scheduled dwell times are very short (i.e., in the range of 30 seconds to 60 seconds) boarding even one disabled passenger would result in delay. It is stations that lie between the terminals that are typically associated with such short dwell-times. In many cases, even costly capacity expansion (such as extra track for through trains and the addition of express service) would not alleviate the problem. As a result, the analysis would need to focus on terminal stations only.

However, if the minimum cost solution is adapted to reflect management policies with regard to **system** delays, the liklihood of an operationally feasible solution diminishes, even if only terminal stations are made accessible. This is the case even under the range of most likely demand. In the case of Lakeshore West Line (Toronto) for example, the normal frquency of late arrivals at the main terminal is such that peak train departures would be delayed 10 percent of the time unless some disabled persons were to be refused entry. Since management would be unlikely to refuse anyone entry, late departures would also delay trains on other lines that are awaiting entry into the terminal station, leading to **system-wide** disruption about one-tenth of the time.

Although the scale of such disruption is small (less than 30 seconds) and manageable, if disabled passenger demand were to reach about half the maximum conceivable projection (about double the most likely range), such disruption in the Lakeshore West example would occur more than 80 percent of the time due to the compound effects of normal deviations from train schedules. Thus, even if management were to be willing to modify its policies and tollerate peak disruption 10 percent of the time, it would also need to consider the risk of incurring such disruption at virtually all times.

While this risk is small (because the probability of achieving half the maximum conceivable demand is small), accesibility would place management under pressure to do all it can to boost demand levels through advertizing and so on. Large-scale operating disruption could thus prove to be a "self-fulfilling prophesy", in the longer term.

Further operational risks exist in the off-peak period. In the Lakeshore case for example, management would be unable to make Exhibition Station -- a station serving sporting and other mass events -- accessible without adding at least six trains to accommodate disabled passengers under even likely demand levels. Since operating conditions do not permit the addition of six trains, this station could not be made accessible; disabled passengers would thus need to be transported to special events by feeder service from the nearest available station.

Finally, a management policy that permitted no seat loss due to the incorporation of wheelchair tie-down positions could render accessibility infeasible in a tightly constrained system. In the Lakeshore West system, for example, adding trains is operationally infeasible at certain times of day.

ECONOMY OF ACCESSIBLE COMMUTER RAIL

In the range of most likely demand for accessible commuter rail service, the case study results indicate that both accessible fixed route buses and interregional door-to-door paratransit service are likely to occasion lower 30-year costs than making commuter rail service accessible. This is the case even where no costs are occasioned by the feeder service. Feeder service would be necessary however in order to achieve the range of likely demand projected here; with feeder costs included, total 30-year costs for an accessible rail system range from $15 million to $30 million in the Toronto case and from $5 million to $10 million in the case of the Rigaud Line, Montreal. Such expenditures represent more than five years worth of <u>total</u> spending on commuter rail in these cities today -- a huge committment of resources relative to expected use.

As shown in Figure 4, the 30-year cost of making the Lakeshore West Line in Toronto accessible to disabled persons would not "break even" with interregional paratransit costs unless the number of disabled passenger-trips on the commuter rail service exceeded the likely range by at least 30 percent, a particularly unlikely outcome with only two accessible stations. This assumes, moreover, that no additional railway attendants would be required; if 66 such attendants were to be required then accessible commuter rail costs would exceed the cost of paratransit unless maximum demand was achieved. (At that point, however, operational feasibility would be in doubt, as indicated earlier). These conclusions assume, moreover, that feeder service would not occasion additional costs over and above the costs associated with existing paratransit services. It was shown earlier that this assumption may be in doubt in the Oakville area unless severe paratransit rationing was imposed. Without such rationing -- which would suppress many existing paratransit trips -- accessible commuter rail service would cost more than paratransit at any level of demand (see bottom section of Figure 4).

Conditions do exist, however, under which the commuter rail approach could realistically be expected to compete economically with paratransit. While the likelihood of such conditions applying in the case of the Lakeshore Line in Toronto is remote, it is less remote in the case of the Rigaud Line in Montreal. As shown in Figure 5, if accessible commuter rail in the Rigaud region can attract the high end of the most likely range of demand -- and if the associated feeder demand can be fully absorbed by existing specialized services with no increase in cost, then commuter rail access costs would be about the same or somewhat lower than paratransit costs. The previous Chapter found that the specialized service in Montreal could probably handle this level of demand without increased cost (perhaps with some rationing), lending force to the argument that accessible commuter rail in Montreal could prove economic relative to paratransit. Note in Figure 5, however, that even under these conditions some delay in current journey times would be inevitable -- about seven percent. Just as roses do not come without thorns, so an economic and operationally feasible accessible commuter rail system would not come without some schedule degradation and losses in existing passenger traffic (of about one to two-and-a-half percent).

On the other hand, however, if demand grew substantially beyond the likely range, then feeder costs would rise and the cost of commuter rail would substantially exceed that of paratransit (see Figure 5, at bottom). Thus at

FIGURE 4 COST PER TRIP OVER 30 YEARS. LAKESHORE WEST LINE: TORONTO

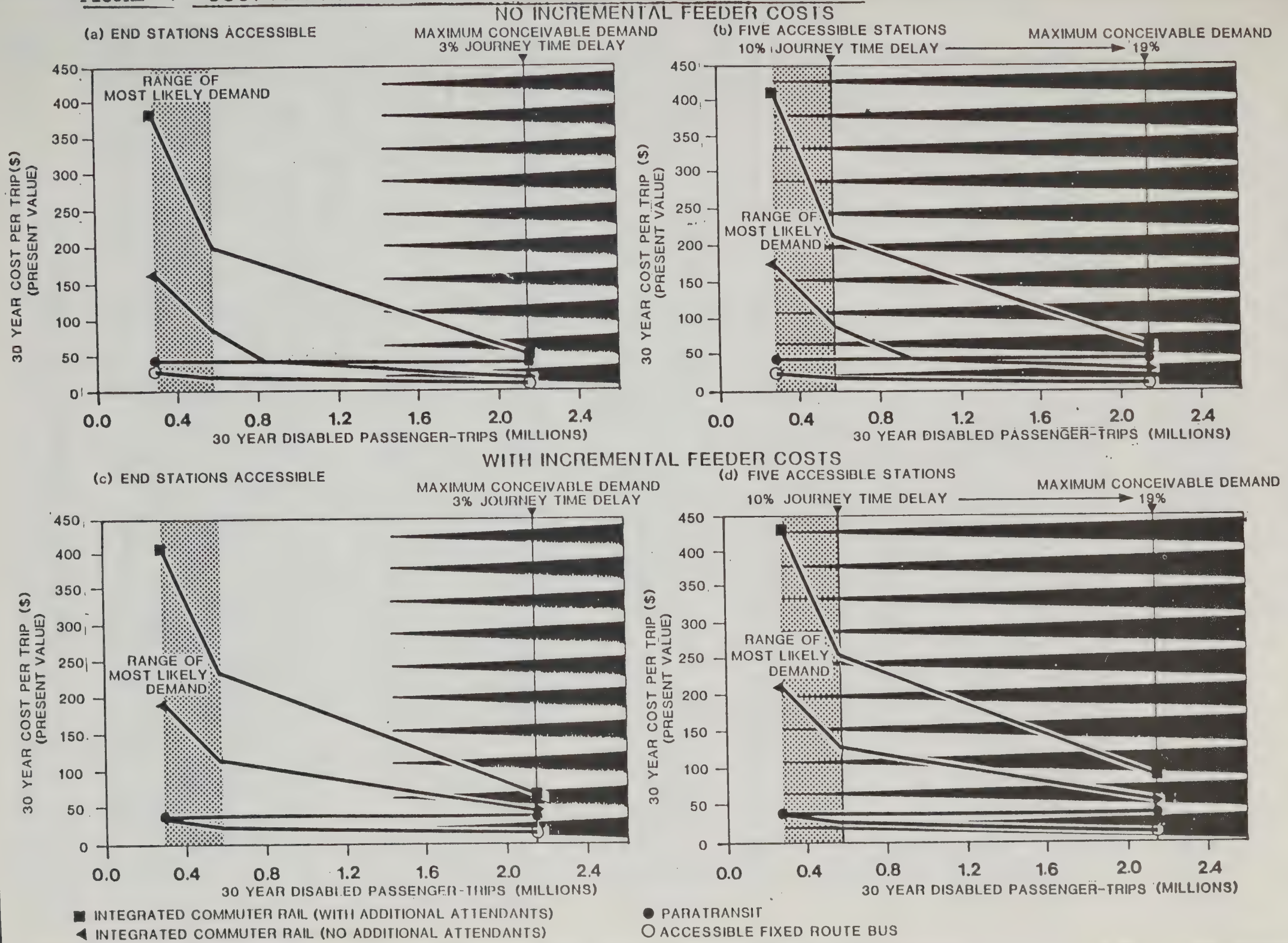
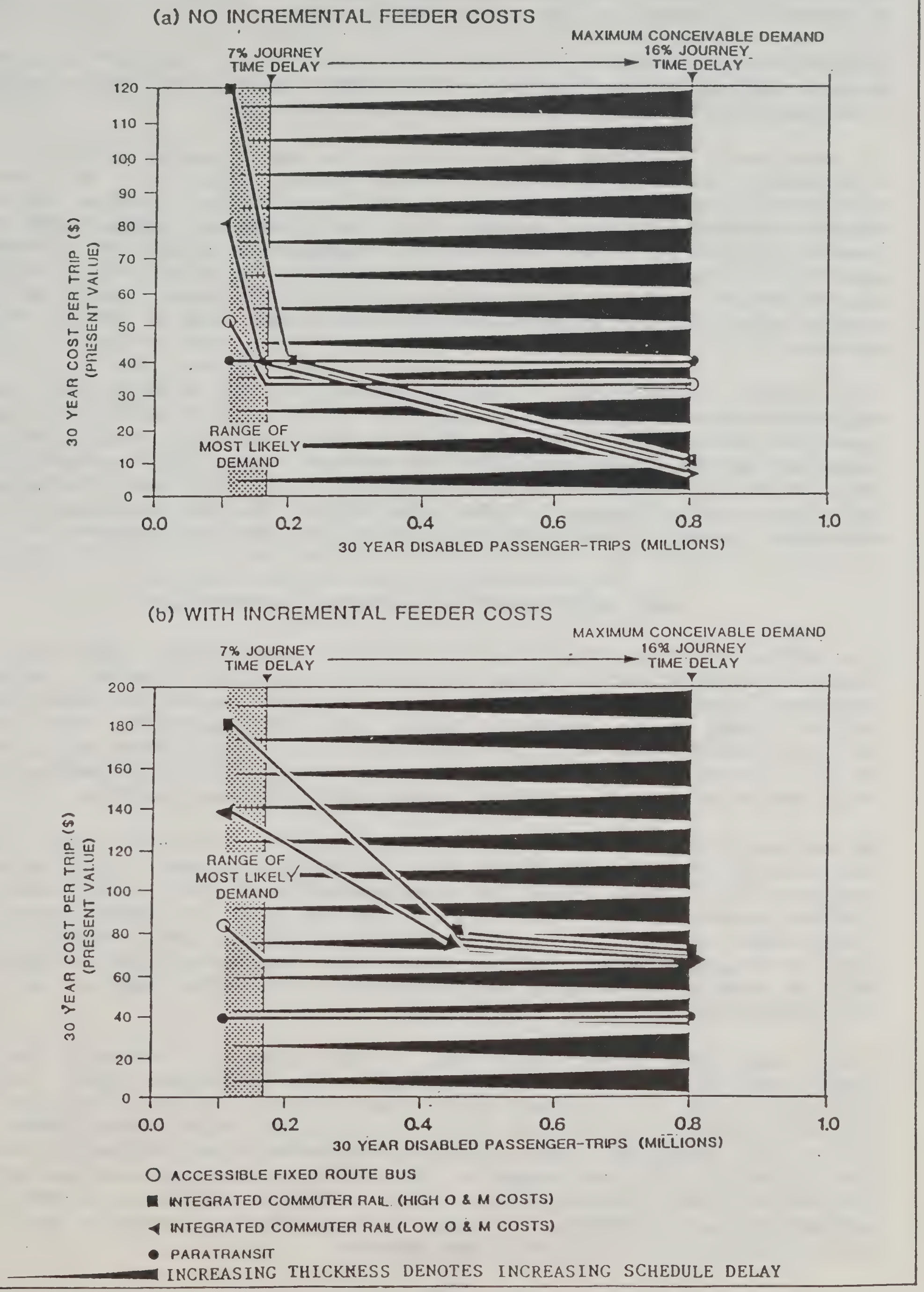


FIGURE 5 COST PER TRIP OVER 30 YEARS
RIGAUD LINE, MONTREAL
(FOUR STATIONS)



the level of maximum conceivable demand, accessible commuter rail with feeder service will generally not prove economic relative to alternative approaches in either case study, and, by implication, in general.

It should also be noted that even where commuter rail 30-year costs fall beneath the costs associated with door-to-door paratransit, the accessible fixed route bus option is likely to cost less than either.

In cases where management policy is such that any potential delay must be alleviated -- and where alleviation entails capacity expansion -- an economic approach is virtually beyond reach. In the Lakeshore West example, capacity expansion needed to alleviate delay at the main terminal station would cost more in capital and added operating and maintenance costs than all other access costs combined, bringing total expenditures well above $100 million over a 30-year period. Furthermore this expenditure would result in only partial alleviation of delay as not all delays stem from a lack of system capacity.

Other policy considerations -- such as the modification of washrooms -- have only small relative impacts on economy. In the Lakeshore West case, the costs associated with station washroom renovation and ramp deicing, results in an increased capital expense of $180,000 if only end stations are made accessible and $720,000 if 5 stations are made accessible. This represents a 1.2% and a 4.8% (respectively) increase in the total 30 year cost to make commuter rail accessible, assuming these renovations are done in the first year.

COST EFFECTIVENESS OF ACCESSIBLE COMMUTER RAIL

Conclusions regarding effectiveness mirror those reported for economy above as shown in Figures 4 and 5. Under the range of most likely demand, cost-per-trip over 30-years ranges up to $400.00 per trip for accessible commuter rail and is likely to be radically higher than that associated with other approaches (paratransit would cost about $45.00 per trip as shown in Figures 4 and 5). Low probability conditions do exist however under which commuter rail could realistically be expected to compete with paratransit service.

In the case of the Lakeshore West line, for example, cost would range from $75.00 to $175.00 under the likely range of disabled-passenger trips versus a cost-per-trip of under $45.00 for interregional paratransit (see Figure 5). Disabled passenger-trips would need to rise at least 30 percent above the likely range to bring direct cost-per-trip into the paratransit range; at this level of demand, however, indirect costs (that is, feeder service expenses) would be inevitable, bringing cost-per-trip for accessible commuter rail for the Toronto line nearer the $320.00 mark.

Again, conditions could apply (as in the case of Montreal) whereby cost-per-trip for accessibility would fall to the paratransit level. At the high end of the likely demand range, cost-per-trip for accessible commuter rail and paratransit would each lie in the region of $40.00. This ignores the journey time delay that would accompany the commuter rail approach, however (see Figure 5). It also hinges on the ability of the existing specialized services to provide feeder service without adding to its costs; if this were achieved through rationing, it would be necessary to recognize that some existing paratransit users would lose service.

Under assumptions that have been revised in the light of existing management policy, any likelihood of a cost effective, accessible commuter rail system would evaporate entirely. For example, if the cost of capacity expansion to alleviate delay in the Lakeshore West system is included, then cost-per-trip rises to some $1,200.00 at the most likely level of demand. At this rate, just ten trips by a disabled passenger would require a subsidy equivalent to the cost of enabling the individual to acquire an adapted automobile.

CONCLUSION

This report presents a methodology and decision-framework for assessing the economic and operational feasibility of making commuter rail systems accessible to disabled persons. Through case study examples, the methodology has been tested and proven to be practical in operation. It enables the policy analyst to devise both a minimum cost, operationally feasible solution while at the same time revealing conflicts that such a solution might pose to existing railway management and government policy.

It is concluded, therefore, that the methodology is complete and transferable to other systems. It must also be stressed, however, that the case study findings are useful only insofar as they demonstrate the methodology's applicability on a site specific basis. The results should not be transferred to other systems, only the methodology itself. It should also be stressed that the case studies presented here are developed only far enough to validate the methodology. Further detailed analysis would be needed in order to develop plans that could form a basis for implementation.

BREAKING DOWN THE ATTITUDINAL BARRIERS TO TRAVEL

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BREAKING DOWN THE ATTITUDINAL BARRIERS TO TRAVEL

I am pleased you are here to help celebrate an anniversary with me. Ten years ago this month marks the beginning of HANDI-TOURS, the first travel program in Canada specializing in tours and individual trips for disabled people. I would like to share with you the beginnings of that program because they are significant to this conference and the theme Mobility in the Global Village.

Over ten years ago, I was working as a medical social worker and became frustrated with a number of inequalities I realized that elderly and disabled people faced. Travel was only one of the inequalities I was aware of but as a seasoned traveller myself, it was the one that spoke loudest to me. It was painfully obvious that the world was not designed with handicapped and elderly people in mind and I set out to discover why and what could be done to rectify such an abysmal situation. I began by researching how travel was addressed in Canada and other parts of the world for and by people who are mobility-disadvantaged. I collected a virtual library of literature including access guides, airline booklets and a few texts written on the subject particularly out of the United States. Few access guides had been done at that time in Canada. But any that had been written in Canada, the U.S. and around the world were not standardized and at times, the criteria on which the assessments were based were vague and hard to comprehend. I then went to talk with airlines, bus lines, the national train carrier, hotels and travel agencies. It was through this research that I realized how the barriers to travel were not only architectural but attitudinal as well. The travel industry were close minded, if not ignorant, about what they perceived as a limited market with no real cost benefit in accomodating. I also realized that my social work mentality interfered with the reasoning required to convince the travel industry that including mobility disadvantaged travellers in design plans is good business, not good will. There was obviously a long road to hoe and the challenge was formidable in terms of developing recreational travel programs for disabled people.

Undaunted by the negative attitudes, I naively persevered and eventually convinced one travel agency to let me use their facilities in order to co-ordinate a tour for physically disabled travellers. This was to be a trial run. I will not elaborate on the sordid details. Suffcie to day that though the tour was itself successful, the planning stages were fraught with both architectural and attitudinal impediments. But the attitudinal barriers far outweighed the physical ones. They were a painful reminder that handicaps extend far beyond the person who is disabled.

What happened in the first endeavor was far more complex than simply arranging a tour and all the detail required. Though that in itself was full of complexities.Finding hotels with more than two accessible room , restaurants and sights with flat or ramped entrances (or arranging this) and especially finding usable and accessible transportation services were challenges in themselves! The trip and the planning were important exercises that resulted in the discovery of the pervasiveness of architectural barriers and the insidiousness of attitudinal barriers. There was a lot to be done and a lot to be learned by us all.

My own educational process is significant and I would recommend it wholeheartedly to every able-bodied person who works is support of disabled people. I began by contacting organizations for disabled people in Toronto and asking if I could meet with handicapped and elderly persons who worked there about the subject of travel. I thankfully never experienced an unco-operative response. I proceeded to meet with many groups of varying disabilities and attempted to determine what people knew or wanted to know about travel and what problems were anticipated or had been experienced. Two wheelchair-bound people became my mentors whom I consulted about various matters.

I then set out to discover the world of a person in a wheelchair from another perspective. I went on my first (and subsequent) pre-trips in which I arranged the itinerary for tours, in a wheelchair. Not an original idea, but the best one I knew how. Though I had full use of my arms and hands, unlike many of the travellers who eventually went on the tours, I was able to subject myself ot the myriad of barriers that are typically faced by people who use wheelchairs. Though HANDI-TOURS were open to all disabilities and to elderly people as well, using the wheelchair as a tool to discover accessibility was useful in order to facilitate the trip for elderly persons, those with walking disabilities, heart problems and prosthesis. The experience of travelling in a wheelchair was frightening for me, eye-opening and at times off-putting. It served a number of purposes, however, such as my advocacy skills and the awareness of inherent discrimination experienced by disabled people. There is nothing like experiential learning and still nothing more effective than expriential learning combined with knowledge gained from the disabled people themselves.

This addresses one of the primary modalities of learning that I believe in and wish to advocate ; that is, the absolute need to be in complete touch with the consumer. There are many ways of doing this besides the ones I chose and have just described. Since my own initial stages of development I have come to realize how necessary it is for all players in the transportation field including the consumer, to be suitably educated. We are all part of a chain that needs to be linked strongly or else each individual effort will fail. It is my contention that the need for education by all players is the strenthening bond.

What methods are viable for designers, engineers, archtiects, travel industry personnel and others involved in designing and providing transportation modes? The most onbvious involves the education system that trains people in the first place. Whether it is a school of srchitecture, engineering, design or tourism etc., all faculties are urged to include in their curriculum awareness training about disabled people and their special needs. Despite limited budgets that many schools decry, there are many organizations for disabled people that would willingly provide speakers to discuss the issues from a disabled person's perspective for students in the various programs, to at least raise awareness. How to plan and design for handicapped and elderly people should be an integral part of each faculty's prgroam of learning. This also entails the inclusion of special needs for handicapped populations in school texts.

The next most obvious method, involves training programs that sensitize desghners, architects, engineers, and so on about the special needs of disabled and elederly populations while also addressing the myths associated with these populations and the insidiousness of negative and ignorant attitudes. Consulting firms can arrange awareness programs of this nature and the most successful awareness programs employ handicapped and elserly people to do the training. Consulting firms can also be instumental in helping engineering, architecture, design and tourism related agencies to employ disabled people to work through all projects - not just those designed with disabled people in mind (though of course, there should be no question about including disabled people on specific projects related to that population). To achieve maximum integration, all transportation modes, buildings and spaces should consider people disabilities. Thoseprojects designed for disabled people specifically require input from from a cross-section abd range of the pertinent handicaps. Focus groups that include a range of disabled people can be co-ordinated by disabled consultants and would prove to be invaluable tools for any firm.

Focus groups also serve the useful purpose of helping to identify the gaps in existing services. The best authority on disabilities and what facilitates mobility are disabled people themselves. So often they are consulted, if at all, after the fact.Too often the cart comes before the horse and money and effort has been spent needlessly.

This kind of logic was also used in the travel industry. For instance, in trying to arrange hotel accomodation for a HANDI-TOURS group I was speaking to a hotel manager who was explaining the lack of 'accessible rooms' in his hotel. He said that it was a matter of supply and demand; that they do not see many handicapped people and therefore, it is not cost-efficient for them to refurbish hotel guest rooms. I suggested that perhaps the old chicken and egg theory applied here. This was to say that maybe they did not se people because the hotel was inaccessible rather than the other way around. I, not surpisingly I am sure, believe that disabled people would not want to frequent a hotel in which they were unable to use the washroom!

It is an age-old story. But why all hotel rooms cannot be accessible with, at least wide enough bathroom doors, is beyond me. There is nothing displeasing as far as I can see to wide bathroom doors. Similarly, fittings for hand rails and other such adaptations that facilitate travel for many are not intrusive. The inherent discriminatory message cannot be easily justified to me and to many prospective travellers in terms of cost efficiency. We are talking about equality here. Similarly, the rationale applies to transportation services. Though totally accessible services may be unrealistic in some cases, too many disabled and elderly people are excluded from using different modes of transportation. They are often forced to use parallelservices, sit in awkward places, transfer into uncomfortable seats, access spaces in undignified manners and adapt tp less than convenient situations. Again, the authorities on the matter are not commonly consulted and included in the process of design and planning from the beginning to the end. As well, the supply/ demand argument fails as does the cost-benefit analysis. We are talking about treating people

like people. The concomitant effect on the general public in terms of breaking the attitudinal barriers by integrating disabled people in all facets of life cannot be overestimated.

It is obvious that anything short of full integrative services of all sorts and in all ways is, again, discriminatory and serves only to perpetuate the segregation of people with disabilities. It is not unlikely that the intrusion of hte state through laws and regulations will be the only way to ensure integration. This method is not without its pitfalls.

The subject of education is also important when talking about rehabilitation personnel. This might surprise some of you that I am suggesting the education of those involved in helping disabled people includes education of the people who are specifically trained in their disciplines to do so! What I am suggesting is that travel and transportation - accessing and using it - be an integral part of all rehabilitation procedures.This is to say, that when teaching activities of daily living, occupational and physical therapists, nurses, social workers and doctors should stress the importance of learning how to access the various systems as matter-of-factly as learning toiletting and bath care. One centre in the United States, I understand, arranges for patients to go to the airport and learn how to use the airport and get on and off planes. The clear message is, YOU CAN DO THIS TOO AND THIS IS HOW. Travel and using transportation then becomes a natural activity.

Lastly, but not least, the education of the disabled and elderly traveller is paramount. My book HANDI-TRAVEL was written to educate this population about travel. The lack of education makes people feel vulnerable and dependent on an unfair system not designed with them in mind. Planning, adapting and preparing for travel are the most important parts of travel for disabled and elderly people. These populations need to know what is available and accessible (and by which criteria). Otherwise the consequent lack of usage leads to the unreasonable plaint of "no demand". Marketing is more important than many professionals realize and too often there are no promotional materials used to inform disabled consumers of what is available to them.

Just as the professionals involved in services for disabled people are urged to take responsibility for educating themselves about the special needs of disabled people and elderly people, similarly, disabled and elderly people are urged to educate themselves about how to access the system. There are many ways to research the available, accessible travel and transportation services and to prepare accordingly. There are libraries that hold pertinent information and for many the planning and preparation stage becomes an important and integral part of the whole travel experience. Able-bodied travellers share this part of touring as well. I can certainly offer more suggestions if there are relevant questions in the audience on this topic.

While there are still many inconveniences in the travel world,for those who want to travel you are urged to examine your own attitudes that may prevent you from enjoying the travel expreience. A sense of adventure, challenge and humour are all important to take along with you. Your integration into the mainstream is dependent in many ways on your prescence, your suggestions and your willingness to fight for equality. Your prescence inspires change as do your suggestions and standing up for your rights. When faced with barriers, it is necessary and important to face them straight on by constructively reporting the problems to the proper people and offering suggestions for improvements.

Further, it is necessary to identify the gaps and speak up loudly as to ensure your right to equal services and treatment is not violated.

In closing I would like to say that we all need to remember our responsibility to ourselves and each other to strengthen the chain that links us. If we truly believe in integration of disabled and elderly people we will work together so that Mobility in the Global Village means mobility and equality for everyone. Again, the need for education will help ensure this goal.

Cinnie Noble

THE NECESSARY RESPONSE TO UN-ANNOUNCED NEEDS OF DISABLED PEOPLE

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United Kingdom

THE NECESSARY RESPONSE TO UN-ANNOUNCED NEEDS OF DISABLED PEOPLE

Claudia Flanders OBE
National Bus Company, United Kingdom

INTRODUCTION

Thanks to worldwide efforts over the past two decades, culminating in the massive publicity generated by the INTERNATIONAL YEAR OF DISABLED PEOPLE in 1981, providers of services for the public have learned much about the circumstances and requirements of elderly and disabled people. Indeed, Disability Awareness — however translated around the world — is today not simply a phrase but a working concept.

However, many managers of services and premises are experiencing serious difficulties in developing their new-found awareness in such a way as to relate successfully to the real practical and attitudinal needs of the disabled and elderly people amongst the public they serve. There remains a tendency to consider those users of public services who have a handicap — caused by physical, sensory or mental disabilities or severe effects of increasing age — to be "apart from rather than a part of" [1] the mainstream of a provider's obligations.

Educative energy devoted by disabled/elderly people and their advocates, added to operational experience, has led to the correction of many misconceptions as to the actual (in contrast to the supposed) aspirations and abilities of "handicapped" users. Thus today an operator will announce the discovery that "blind people really do wish to travel to scenic resorts", or "people in wheelchairs seem to enjoy a disco dance", etc.

But even on this simplest of levels the educative process is incomplete. Far too many potential customers for public services are left out of the mainstream because their desire and need to join it, or their actual practical problems in joining it, are not accurately identified. The gap between perception of a disability and understanding its real implications for the service provider still needs to be bridged.

In the case of so-called "visible" disabilities many crucial factors may be ignored and, if not specifically announced, remain hidden. For instance a person in a wheelchair or using crutches or calipers often receives willing help; but if he is not quick or articulate enough he may also receive a painful jolt as someone pulls or pushes an arm or shoulder. The mere ability to walk may lead to wrong suppositions as to stamina or steadiness. The reason for someone climbing steps exceedingly slowly or deliberately is often not appreciated in a rushed, crowded situation, nor is the risk to a blind person of over-zealous guiding across a street or on rough surfaces.

Where less obvious disabilities and problems may exist, which are seldom announced and may be difficult or impossible to identify visually, the need for developing Disability Awareness is even more urgent. Un-announced or hidden handicaps occur in a majority of disabled people, and nowhere is this more evident than in the world of public transport.

This paper will concentrate on bus and coach services in Great Britain, addressing itself principally to those aspects of disabled and elderly people's travel which now belong within the scope of mainstream provision of stage carriage (bus) and long-distance (coach) services — or could be brought

within that scope by means of minor improvements in vehicle design and staff attitude.

This paper will review operators' traditional perceptions of disability and the effects of recently stepped-up efforts in advocacy and education. It will then proceed to examine the particular challenge presented by users with un-announced needs, concluding with suggestions as to new roles for advocacy in a changing bus and coach scene.

I. Operators' Perceptions of Disability: Apathy into Awareness

A. The Un-identified Market

Until about two decades ago, when the bus and coach industry in Great Britain was reorganised to adjust to the effects of vastly increased car ownership, users of buses and long-distance coaches were considered a more or less assured market. That they were by no means homogeneous may have been recognised, but not in ways which could best serve those who were young, elderly, of modest means or who presented a combination of these elements. Even following the decline in the bus industry there is little indication of any heightened interest on the part of operators in the potentialities of the young/elderly/poorer user group as a stable and even expanding market within an otherwise weakening commercial structure.

This seems surprising, given that even today, of the 71 per cent of Great Britain's adult population who make some use of buses the proportion of younger (age 16-29) users can be as much as 60 per cent [2] and that within the overall 71 per cent at least 20 per cent are over retirement age.[3] We know also that at least 41 per cent of people in Great Britain over the age of 65 suffer from a form of arthritis[4]: as arthritis affects movement, strength of grip, and/or sight and hearing, it is obvious that such people will have severe difficulties in standing in line, boarding and alighting, and moving within cramped spaces — particularly vehicles which are starting up or in motion.

There is thus a clear correlation in marketing terms between the needs of elderly, possibly arthritic passengers (who may be handicapped not only by reduced financial resources but by shopping bags or wheeled baskets and/or a small grandchild or two) and those younger users who may also have limited means and include expectant mothers, families with small children, pushchairs and often shopping or luggage to manage as well. Yet this marketing opportunity has so far not been taken up in any concerted fashion.

On the contrary the major bus companies, bedevilled as they have been by reorganisation, stringent finance limitations and the advent of total deregulation (Transport Act 1985), have been reluctant to initiate any improvements in service or vehicle design which could not immediately show up on the Revenue rather than the Expenditure side of their balance sheets.

Here are two illustrations of the prevailing "balance sheet" approach to bus and coach operation which affect particularly the users whose needs are generally un-announced:

1. With the introduction of mini-buses on a variety of services around England over the past two years, many more housing developments and other residential concentrations of bus users have been reached; services have been frequent and fares low. But due to the desire for minimum cost and maximum immediate profitability, the vehicles chosen for use as mini-buses (Ford Transit and Mercedes vans) were not examined as to their suitability for elderly or young-family users in particular.

Many elderly people initially welcomed the new service which brought friendly, frequent transport so close to their homes: it seemed that at last a way was open to move out and about with less walking and more freedom. But the vehicles themselves, with their high steps and lack of space for long thighs, stiff knees, granchildren on laps, or shopping, proved far less "user-friendly" than their drivers. Large numbers of elderly people who live in areas where the new service is temptingly on offer, are sadly returning to their previous pattern of transport — dependence on far-removed bus services or private help.

The reasoning behind the deployment of the Ford and Mercedes vehicles was attention to the "bottom line". It was, in the very short term, financially sound reasoning: passenger numbers and revenue showed a quick upswing. But whose bottoms actually find a place on the new lines has so far remained a secondary consideration.

2. In the holiday and touring sector of the industry (mainly using coaches) the proportion of users over retirement age has long been known to be higher than is the case in stage-carriage bus services — 35 to 40 per cent.[5] Yet National Express, Great Britain's most important coach operator, has so far postponed implementing any system which could ease the seat allocation situation for passengers whose disability or frailty make standing in line and reaching (also riding comfortably in) rearward seats an extremely anxious and painful experience.

It would appear that in the uncertain and capricious world of coach service competition any additional expense in equipment or staff time is to be avoided. Meanwhile the proportion of young, unencumbered and agile users, currently assessed at 58 per cent[6], is such a beguiling statistic that other user groups must be assumed to be content with the (admittedly generally excellent) services as currently run.

The above is obviously bad news for all those in the bus and coach using public who, though ambulant, are mobility handicapped in some way. It should also be seen to be bad news as regards commercial strategy: these users, given certain minor or nil cost improvements to bus/coach service and design, could offer significant and abiding future support to an otherwise declining or struggling undertaking.

In Great Britain as in a large part of Europe generally, about 10 per cent of the population are disabled in some way, and an even greater number are mobility handicapped in the use of transport.[7] To ignore this sector of the public would seem unjustifiable in both Disability Awareness and marketing terms.

B. Awareness Today

The persisting approach of the average operator, and more importantly his ground and driving staff, is weighted on the "humanitarian" side: it is based on ad hoc "good will" as applied to the incidental user who is seen as belonging to a small minority. (Indeed, where wheelchair-bound passengers are concerned this smallest of travelling minorities is not even seen to be part of the operator's remit at all, except on a very few and much-appreciated services. But this area of provision is itself outside the remit of the present paper; it has been studied in detail by others[8].)

Obstacles to real perception of disabled people's needs and problems can be noted in semantic terms: many operators refer to "crip ples", "invalids", and "wheelchair cases", not individuals. There is no doubt, however, of the store of kindness and common sense which could, with encouragement from advocates, be put to better and more acceptable use in the transport industry.

C. Advocacy

The publicity spotlight afforded by INTERNATIONAL YEAR OF DISABLED PEOPLE has led to the establishment of committees, advisory groups and even consultants (such as myself at the National Bus Company, 1980-86). Operators have thereby been brought into close touch with some of the real practicalities of elderly and disabled people's travel needs. Progress has been made, but advocacy at its most basic level has had a very limited effect across the bus industry generally.

Most managers of companies (with the exception of a very tiny number of executives) are not themselves disabled and it seems a fact of human nature that effective advocacy needs to come from those who actually have first-hand experience of disability.

An over-tall but agile person, for instance, may stumble over an unmarked step through inattention; an overweight but otherwise "able-bodied" passenger may teeter backwards in the struggle to climb a high step without benefit of a graspable handrail. But if the person experiencing such difficulties is definitely "disabled" (partially-sighted, arthritic, etc.) a very definite reaction is produced.

Increased contact with and pressure (and information) from advocates who are themselves disabled, has helped certain forward-looking operators to begin to examine the place of the elderly or disabled passenger in mainstream public bus/coach transport. Certain of their passengers' less daunting difficulties have been identified, and as a result better types of signing have been introduced in some stations, many buses have clearer step-markings and handrail colour contrasting, and more attention has been paid to station seating and to the clarity of publicity — oral and printed.

Although many operators still have "semantic" problems they do now tend to refer to disabled people rather more imaginatively — as "less athletic", "less able" or "disadvantaged". (It would, I suggest, be enormously useful if advocates could settle upon and keep to the use of a few acceptable phrases which operators could adopt and use with confidence. At present there are too many "in" words which too soon go "out"!)

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II. Future Prospects

A. Awareness Tomorrow

Important vehicle design changes will continue for the foreseeable future to present excessive burdens in expenditure. But many operators (or groups of operating companies such as the National Bus Company, through mid-1986) have attempted to develop the training aspects of their approach whilst not eroding the pre-existing very valuable resource of ordinary staff kindness and good will.

A recent bus driver training film produced by the National Bus Company, entitled "Just a Thought", contains evidence of an effort to encourage sensitive thinking and perception on the part of staff, particularly in regard to those categories of disability which are most often either not accurately assessed by staff or un-announced by the passenger. It is worth noting that such modest funds as were devoted to the making of the film were so allocated solely to reach drivers as a staff group and not to improve the "image" of NBC generally in the disability world.

The following outline presents several out of a wide range of handicaps likely to be encountered by a bus or coach driver during a day's work. The types of mobility handicap are listed in order of their familiarity and ease of perception by the driver, and in each case an indication is given of the driver's probable mental response according to his or her general job orientation — how the mobility handicap may or may not fit within so-called normal patterns regarding driver communication with the passenger, other passengers' reactions, and the driver's personal preoccupation with fufilling timetable obligations.

1. Advanced pregnancy/advanced age, children (in arms or toddling):

   Very familiar, communication normal, other passengers reasonably patient, delay expected as "par for the course".

2. Crutches, arm sling, obvious visual handicap (white stick, guide dog, very thick spectacles):

   Reasonably familiar, communication normal, other passengers patient and often supportively helpful, no threat to time schedule.

3. Obvious hearing impairment (including total hearing loss):

   Communication difficult, passengers impatient, some doubt as to intelligence (even sobriety), nervousness as to timetable delay.

4. Multiple Sclerosis, cerebral palsy, mental handicap:

   Communication possibly baffling and lengthy, passengers embarrassed, impatient or both, serious doubts as to intelligence and/or sobriety, extreme worry over delay.

5. Cardiovascular conditions, painful forms of arthritis, minor hearing or sight impairment:

   No unusual communication difficulty, passengers unaware, no special worry.

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For those of us involved in encouraging awareness amongst staff — and their employers — in the bus industry it is easy to identify which of the above categories deserve the most serious attention but are by their very character the hardest to "get across" in training programmes or through other channels where advocates can play a role.

B. Tomorrow's Advocacy

As a result of the positive contacts of the past decade, today's advocates are now mainly drawn from the ranks of those who have first-hand experience of disability. They are members of rather than deputies for the groups they represent. This is an achievement to be noted above all others.

But the "handicap" which we ourselves suffer, working with or around the bus industry, is the knowledge we gain. Even minor design or other improvements, if they are to be effective for all mobility handicapped passengers wherever they wish to travel, must be introduced on a large scale: thousands of vehicles will need re-fitting or replacing; hundreds of stations will need uniformly improved facilities such as accessible toilets and coffee shops, clearer signing etc.; and the entire approach to publicity and information will need re-examination through the eyes, so to speak, of the partially-sighted — not to mention the conventional public address system which at present reaches so few of the hard-of-hearing.

As for staff training programmes, they must be provided often, and made available (even compulsory?) for thousands of staff members if they are to take account both of the subtleties of disability awareness concerning un-announced mobility handicaps and of normal personnel turnover.

To be credible and effective within a competitive and fiercely struggling commercial area such as public transport, advocates must resolve to reflect a genuine understanding of the pressures and costs implied: this is no more nor less than what they themselves would ask of operators, regarding disabled people's problems and needs. To this end advocacy must be offered on an ever-increasing scale, wherever it is seen to be needed, in the spirit of collaboration, not confrontation.

CONCLUSION

The consultation of today could not have been brought about without the campaigning of yesterday. Yet to attain true integration — which must mean willing recognition and responses where un-announced as well as obvious forms of handicap are concerned — we must do much more to encourage operators in their perception of the factors emphasised at the outset of this paper. Operators of bus and coach transport, like their counterparts in rail, air and sea travel, must be given clearer indications as to the commercial and not just "humanitarian" validity of improved conditions for their users and would-be users. What is better for those passengers who have special needs but do not always announce them, is undoubtedly most attractive to all passengers — including those able to make choices between competing services.

Last year over 6 billion passenger journeys were made by bus and coach in Great Britain.[9] With the help of constructive advocacy and collaboration, we may hope that future journeys may be carried out with more comfort and less anxiety.

...end

FOOTNOTES

1. Alf Morris, MP (1977)

2. Department of Transport Statistics Bulletin, 1984

3. Transport Road Research Laboratory Report No. 923

4. ARTHRITIS CARE Report, 1979

5. National Holidays figures, 1982-85

6. National Express fig.s, 1985

7. Report on Transport for Disabled People, European Conference of Ministers of Transport, 1986

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Understanding of the Current Transportation Needs of Elderly and Disabled Persons

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Understanding the Current Transportation Needs of Elderly and Disabled Persons

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In past years, the disabled community has, by its own choice and through the circumstances of its demographics, divided itself into small groups that focus their attention on the unique circumstances of a particular physical or mental disability. Largely, this approach has been quite successful in that it has provided a mechanism to ensure the adequate and complete delivery of service. In fact, in terms of direct service delivery to the disabled, this system functions extremely well. Where this segmented approach has found limited success is in the area of direct consumer advocacy. With the disabled community being divided into small, specific disability groups, there is an inability to find a strong and unified voice to address broad issues of concern to the whole of the disabled community. This inability has frequently resulted in the slow recognition and effective development of key issues of concern to the entire disabled population. The transportation of the disabled and the elderly is just such an issue that has been slow in its recognition and development.

Transportation, having received limited attention in the past, has become a critical issue for the disabled due to changing social trends. Today the disabled are achieving greater social integration in terms of education, employment and leisure. This trend alone has required that the disabled community have full access to transportation systems in order to facilitate such integration. To permit participation in community-based training and rehabilitation programs, and to secure subsequent entry to the many employment opportunities currently emerging as a result of new technologies, the disabled, like the general public, require unlimited access to modern transportation systems.

Beyond the level of employment and education, much of society's leisure is linked directly to transportation. As metropolitan areas expand, and as the trend toward suburban living continues in its popularity, the enjoyment of cultural, recreational, and social activities become directly linked to one's ability to travel. Since so much of the socialization process is dependant upon access to culture and recreation, it is

essential that the disabled gain full and barrier-free use of modern modes of transportation.

Transportation, and the issues related to its access for the disabled, is an area that will only be fully explored if the disabled community is able to put aside its normal segregationalist thinking, and is prepared, if only on this single issue, to work toward a collective goal. While specific groups of disabled people may have very different needs related to access to transportation, there are common issues to be explored. By examining these broad issues, and by collectively advocating for change, solutions can emerge and long overdue progress can be made.

The first major need related to transportation for the disabled involves the process of informing the public, government and transportation authorities of the critical need for the disabled to have access to transportation. In a society where the disabled are today receiving greater attention, this process may not be as overwhelming as it might have been only ten short years ago. Current day city planners, municipal officials, transportation authorities, and carriers themselves are keenly aware of the need for the general public to have access to efficient transportation systems. Thus, informing these same individuals of the similar, and perhaps more dramatic need of the disabled, need not be a major involvement.

Once the need has been effectively demonstrated, a mechanism for communication must be established. We cannot simply expect that government offices and transportation officials are capable of meeting our needs in isolation. We must be able to communicate our needs through an ongoing dialogue. This dialogue might rightly take the form of a kind of mediation process that attempts to realistically consider the need both from an industry and a consumer point of view. The dialogue, if it is to be effective, must focus on common needs related to transportation of the disabled rather than upon the specific needs of individual groups that can be better dealt with as a specific target group study.

But are there common needs related to transportation of the disabled? Are there indeed issues that effect access to transportation for a large segment of the disabled population? Clearly, the careful identification of these needs is essential to the development of an effective strategy for advocacy.

Our first response to considering the needs of the disabled as they relate to transportation, is to consider the overwhelming obstacle of barrier-free design. A disabled individual, whether blind, in a wheelchair, or walking by means of mechanical braces, must be able to board the major forms of transportation. In recent years, this problem has become less of an obstacle as

transportation carriers begin to become sensitive to the physical needs of specialized groups. It is reasonable to argue, however, that once the initial concept of barrier-free design has been promoted, specific design needs are best addressed by individual groups representing a specific segment of the disabled population. This is perhaps the most logical approach in consideration of the widely divergent requirements for design modification. Once physical access has been addressed, there are a whole range of other needs to be addressed in common.

In order to make effective and full use of transportation systems, whether within a single city, or across a nation, the disabled, like the general public, require access to information. Information that goes beyond that presented to the general public, but information to alert the disabled to the special facilities available to them. Such information should include details on physical access, pre-boarding services, medical attention, attendant care procedure and other facilities specifically designed to meet the needs of those with a physical or mental disability.

Naturally, any information that is designed for the disabled must be fully accessible to that community. Therefore, alternate media materials including large print, braille and audio format, are critical.

Once suitable and accurate travel information is available, the distribution of such information becomes a key concern. In order for travel information to be accessible to the disabled, the information must be located where the disabled are located. Service agencies, rehabilitation centres, government transportation offices and consumer organizations of disabled people are all suitable points of access. Travel newslines and toll-free information lines could also be employed to ensure access to up-to-date information.

After full access to accurate travel information has been established, access to the travel environment must be addressed. There is a common misconception that once barrier-free operating equipment is available, so to is transportation for the physically disabled available. There is, however, an entire network of airports, train stations, bus terminals, and other boarding points that must be considered in terms of functional access. Such environments, when unfamiliar, can be a complex world of obstacles.

Much of our transportation environment is communication oriented. Signs are placed to provide directional information. Announcements are made to inform of departure points, schedule changes, boarding times and other critical messages. The oral exchange of information is also an essential part of ticket pur-

chase, seat assignment, boarding procedure and service assistance. Such an environment, so highly communications oriented, becomes functionally meaningless to the blind, the deaf, and those with other communication disorders.

Beside difficulties with communication, the travel environment becomes extremely complex for the disabled traveller in terms of orientation. For the sensory disabled such as the partially sighted, and those with hearing impairments, the travel environment can be one of confusing sounds, difficult physical designs, poor lighting, and swift movement. When depending upon sounds and a sense of space for orientation, the environment of an airport or train station becomes almost impossible to navigate.

The travel environment presents further difficulties in terms of specific tasks required of the traveller. When travelling outside of the country, one is required to undergo customs declaration. Customs personnel encountered are rarely familiar with the special needs of the disabled. The same is found to be true of security personnel in most major airports. This is not to be misrepresented as a fault of the particular personnel, but merely a further barrier to be encountered within this unusual environment.

The travel environment also presents the disabled with severe limitations in terms of rest areas, dining facilities, washrooms and other points of service. These areas are rarely designed with full consideration of the mobility restricted and those with sensory-related disabilities. For these individuals, accessibility to the travel environment quickly becomes dependant on attendant assistance.

The issue of attendant assistance has long been a debate both among transportation carriers and within the disabled community itself. For many disabled people, the requirement of a travel companion is viewed as a loss of independence and a failure in terms of social integration. Dependence upon a travel companion also restricts time and frequency of travel, and in many instances becomes a severe economic barrier.

A popular solution to the problems associated with attendant assistance has been the provision of such assistance by the carrier within the transportation environment. Attendants are trained by the carrier to provide services such as ground assistance, pre-boarding and arrival assistance. The frequent difficulty with this approach has been that the function of these attendants is not limited to assisting the disabled, and such assistance is often a very infrequent and minor portion of their overall responsibilities. The result is that disabled travellers, through no real fault of the attendant, are frequently lost in the shuffle.

A more successful approach to attendant assistance has been the provision of personnel within the transportation environment whose sole training and responsibility is to assist the disabled traveller from the moment of arrival at the point of departure to the time of departure. Upon arrival at a destination or transfer point, another attendant, specifically designated to assist the disabled traveller, provides similar service. The result is that the disabled traveller is not required to cope with a communication-oriented environment and can travel independently.

The major barrier restricting access to modern transportation systems by the disabled traveller, still remains an economic one. Despite a new awareness of needs, and despite the tremendous attitudinal changes that have taken place in recent years, economic barriers remain. Provision of specialized equipment, alternate media information, and specifically trained personnel, represents a major cost, and indeed, sometimes an unreasonable cost for the transportation industry. It is extremely difficult to argue that the provision of such services can be cost-effective. It is equally unreasonable to expect that the tax payer should be responsible for the provision of such services.

From the industry point of view there is, for obvious reason, a frequent economic argument that providing a barrier-free travel environment does not economically viable. Many argue that few disabled individuals actually utilize transit systems. As pointed out by a 1980 Transport Canada study, this argument fails to fully consider the matter:

> ...some people ask how many will use an accessible system and point to the few disabled who manage to fly. What is forgotten is that a) the handicapped have been humiliated and intimidated in the past, b) many disabled people will have to learn how to become safely mobile, and c) this generation of young disabled people will have both higher expectations and greater experience with mobility than their parents.[1]

Further, there is no logical reason to correlate the present use of transportation systems by the disabled with future use should barrier-free transportation systems emerge. Disabled consumers presently not using transportation systems may not be doing so because of present inaccessibility.

From a consumer point of view, a strong economic barrier is also dominant. Most of the disabled population are unemployed or are earning limited incomes that do not afford full fare travel. Where

travel is dependant upon a companion or attendant for medical or accessibility considerations, the economic barrier becomes even greater. While some carriers do offer travel concessions that might allow for a discount or free fare for attendants, these concessions are not universal for all physical disabilities and are often based on medical, rather than functional criteria.

Having identified common transportation issues including customized information, access to equipment and the travel environment, communication needs and attendant care, one begins to realize the tremendous need for strong and effective advocacy. Such advocacy requires a unified voice that demonstrates both the urgency and the scope of the need.

Perhaps the most relevant place for such unified advocacy to begin is at the government level. Ultimately, it is the government that is responsible for overseeing transportation and for ensuring equal access to transportation. While this is generally the government's responsibility, one must be careful to clearly identify the level of government responsible. In Canada, the Federal government is not responsible for all forms of transportation. For example, motor vehicle transportation, some ferry services, as well as major urban transit systems all fall under provincial jurisdiction. Provinces and municipalities generally share costs for public urban transit systems and privately owned transit systems for the disabled. Clearly, the careful identification of government responsibility is critical.

In drawing government attention to the issues related to transportation for the elderly and the disabled, it must be demonstrated that much of the government's other programs related to the disabled are directly linked to transportation. The success of programs targeted to assist the disabled in terms of education, training, employment and rehabilitation, by the very design of our society, are directly related to the ability of the disabled to travel to centres operating such programs and services. Unless access to transportation for the disabled is addressed along with other programs, innovative strategies to assist the disabled become limited to their geographic scope. And as stated earlier, education and employment hold a direct relationship to transportation.

Collective advocacy at the government level requires the disabled community to establish some body that is capable of being representative of the entire disabled population. Such a body must, by the very description of its task, include the mobility restricted, those with sensory handicaps as well as those with communicative disorders. The establishment of

such a group is no easy task, and a mechanism must exist for that body to channel the concerns of the larger community. In order for governments to respond to this body, the group must be fully endorsed by the whole of the disabled community, and must be forceful in its various levels of presentation.

In presenting issues to departments responsible for transportation within the government, we ought not to expect that they are capable of providing significant remedies. While legislative powers clearly exist, such an approach does not provide meaningful solutions, nor does it deal with the major economic considerations. Instead, we ought only to expect that government officials will become sensitive to the need and be willing to participate in programs designed to address the issues involved.

A far more difficult task facing the disabled is to be found in establishing an effective means of advocacy with the transportation industry. Convincing the government of need is not always difficult, since it is in part their mandate to respond to consumer need. Industry, however, while being responsive to consumer need, is far more business oriented and is concerned primarily with operating a successful industry.

Despite the realistic difficulties associated with advocacy at the industry level, there has emerged in recent years a genuine willingness on the part of transportation carriers to provide moderate solutions to the needs of the disabled. Industry, in recognizing the important role of transportation in our society, also recognizes the significance of access to transit for the disabled. What industry lacks, is an understanding of the real needs involved.

Given the genuine interest of industry representatives in assisting the disabled, an ideal methodology to be employed is one based on cooperative problem solving. With the government, industry and the disabled working together, realistic solutions can emerge. This approach, unlike legislative measures, is strengthened by a willingness to work toward a common goal. The disabled possess a detailed understanding of the issues involved and the possible means of obtaining solutions. The government as the responsible party can take a leadership role in demonstrating concern. Industry, the group required to take the most action, is able to present their concerns and the realities involved in an accessible transportation system.

One of the dangers that is always associated with advocacy by the disabled community, is the emergence of an attitude that adopts a stance based on legal right. While the Canadian Charter of Rights and Freedoms does provide protection against discriminatory actions in the delivery of service, this by itself does not

represent a right to accessible transportation for the disabled. To adopt this stance can only serve to threaten and cause greater friction and a further attitudinal barrier. Instead, an attitude of open cooperation and understanding should prevail. It is only with this understanding in place, that effective advocacy can be achieved.

Unless the disabled community begins to work together on important broad issues such as transportation, little real progress will be made. Historically, groups of disabled consumers have been jealous of one another's accomplishments in raising public awareness, gaining the attention of government and successfully attracting the required funding for effective advocacy. We must begin to put these attitudes behind us, and strive to find a common voice the places emphasis on similarities and common needs rather than differences.

NOTES

[1]Transport Canada, _Transportation of the Handicapped: A Discussion Paper_ (Ottawa, Ontario: Supply and Services, 1980), p. 27.

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"THE ROLE OF A VOLUNTEER ADVOCACY COMMITTEE IN THE DEVELOPMENT OF AN URBAN TRANSPORTATION SYSTEM FOR THE PHYSICALLY DISABLED IN OTTAWA-CARLETON"

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THE ROLE OF A VOLUNTEER ADVOCACY COMMITTEE IN THE DEVELOPMENT OF AN URBAN TRANSPORTATION SYSTEM FOR THE PHYSICALLY DISABLED IN OTTAWA-CARLETON

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1. ORIGINS AND FOUNDING OF COMMITTEE FOR URBAN TRANSPORTATION FOR THE DISABLED (CUTD)

The lifestyle of disabled persons living in the Ottawa-Carleton Region has changed dramatically in the last ten to twelve years. This is due in large measure to the establishment of an accessible door-to-door public transportation system called "Para Transpo". The name "Para" is short for "parallel" and signifies a service parallel to the regular public transportation service (OC Transpo) in Ottawa-Carleton.

There was a growing awareness in this region in the early 1970's of the need for a public transportation service for physically disabled persons who could not use the regular urban bus system. Volunteer drivers, taxis and a charter bus company with lift equipped vans were supplying transport. Employment, post secondary education, recreation, and social programs were limited because of the lack of adequate low cost accessible transportation. Accordingly, five members of the Ottawa Handicapped Association met in September 1972 to see what could be done about the situation. Realizing the need for a broad base of support in the community to achieve its ends, the group sought help from the Social Planning Council of Ottawa Carleton, a United Way funded organization which supplied resources and staff support. The group set out to establish a committee made up of representatives from Provincial and Regional social service departments, medical centres, organizations of disabled people as well as interested citizens. Thus the Committee for Urban Transportation for the Disabled (CUTD) was founded, with twelve members, composed of disabled and non-disabled persons, to work for the establishment of a door-to-door accessible public transportation system.

CUTD agreed that the type of accessible service should be a door-to-door pick-up service rather than trying to make the regular transportation system totally accessible. The rationale for this was that while the latter is very desirable, it does not meet the need of many disabled people who could not get to a bus stop. Another consideration is the limitation imposed by the harsh Canadian winter climate. Mobility in snow and ice as well as one's physical endurance of the cold are restricting factors.

One of CUTD's first tasks was to decide the eligiblity criteria for such a service. It was recognized that there were a substantial number of people in the community for whom the public transportation system presented difficulties. The frail elderly, the mentally

disoriented, some blind people, as well as those whose physical disability prevented them from walking, or mounting the steps of the bus. For people in wheelchairs, even transport by car was often difficult. Therefore, this latter group was deemed to be the most in need, with the least alternatives open to them, requiring specialized lift-equipped vans. Another high priority group consisted of those physically disabled persons who could not walk to the bus or mount the steps. Being denied access to the regular urban transportation system such people required pick-up at their door in cars or vans. Persons with mental disabilities or blindness could use the regular bus system with guidance or an escort. Thus CUTD settled upon the target population for the specialized service, as those who could not physically board the bus, the criterion which was subsequently endorsed by the Regional and Provincial governments.

2. THE ROLE OF CUTD IN THE ESTABLISHMENT OF THE SERVICE

One of the objectives of CUTD was to become a knowledgeable and credible body to which the public, governments and the social service and health systems could relate. Accordingly, over fifty groups, agencies and organizations were contacted, informing them of the aims and objectives of the Committee, and enlisting their support. Relevant literature and publications were acquired and kept as a resource library.

CUTD recognized the need to have sound statistical data on which to base the extent of the demand. At that time (1973) the Regional government was conducting a study for the regular urban bus transit service. A consulting firm, De Leuw Cather and Company had been hired to acquire data and make long range proposals[1]. CUTD realized it was vital to have the needs of disabled persons included in this study and it lobbied the Regional government successfully to have this done. There was need for additional data, so CUTD approached the graduate School of Social Work at Carleton University. Aided by a federally funded "Opportunities for Youth Grant", some graduate students embarked on studies which supplemented the data being developed by the consultants[2].

Along with the studies, practical evidence of the need for transport services was being provided by a group of fourteen young men with cars who had obtained a federal government "Local Initiatives Program" (L.I.P.) grant. Their project named T.O.A.D. (Tasks Odd and Diverse) was originally conceived to run errands for people in need. However, when the Committee made them aware of the great need for transportation services for disabled people they began providing transport in their own automobiles. This was quite informally organized, with no registration required, and ran five days a week from 9 a.m. to 5 p.m.. Although of limited duration (1972 - 1974) the L.I.P. grant to T.O.A.D. showed unequivocally the great demand for transportation, and it was the foundation on which the Para Transpo System was based.

Before the termination of the L.I.P. grant in 1974 the main role of the Committee was lobbying the Regional government to continue the service by providing financial support. Reluctantly the Region agreed to support T.O.A.D. on an interim basis until the consultants' report was received. When this was completed in 1975, the Regional government acknowledged its responsibility to provide transport, and gave a three-year contract in 1976 to a private bus company which had vans with lifts. Eligibility for the service was based on the criteria which had been previously established by CUTD. Only three types of trips qualified, those considered priority were work, medical and post secondary education, and were available five days a week from 7 a.m. to 7 p.m.. Reservations for trips were made a day in advance. Transit authorities were still only indirectly involved, administering the funds and monitoring the service.

The goal of CUTD was to have transportation available for all types of trips including recreation and social, and to have the hours extended to evenings and weekends. Constant pressure by the Committee achieved results, and in 1977 all trip types were included, and the following year evenings and weekends were serviced. Still lacking was a funding commitment from the Provincial government. CUTD and the Regional government had been lobbying the Province to subsidize the service for disabled persons as is customary for the regular system. The Province agreed in 1976 to provide funding for two years for pilot projects in five Ontario cities, one of which was Ottawa. Provincial subsidy was available only for priority trips on weekdays. At the termination of the pilot projects the Province established a permanent funding policy in 1979 for full subsidy of the Para Transpo System.

3. ONGOING ROLE OF CUTD

While this major goal had been achieved, there was still an important role for CUTD to play. The lack of experience or a model for this type of system resulted in the need to blaze new trails. There were no safety standards, and the Committee sought to have these established. Transport Canada was approached and referred the Committee to the Canadian Conference of Motor Transport Administrators. This group agreed in 1978 to establish a sub committee on safety standards and invited CUTD to send a representative. A disabled member of the Committee who used the Para Transpo service was delegated. The Canadian Standards Association took over the task and the CUTD member attended meetings over a five year period offering valuable practical consumer input. In 1984 the Canadian Standards Association brought out safety standards for persons in wheelchairs being transported in a moving vehicle[3].

Another contribution which CUTD made was the introduction of monthly bus passes. Requested of the Regional government and effected during the International Year of Disabled Persons in 1981, it marked another step towards making the Para Transpo System more parallel to the regular OC Transpo System.

The Committee continued to play a constant monitoring role. The demand for the service was growing. With the availability of low-cost specialized transportation, more disabled people could secure employment. One disabled young man in a wheelchair, who is employed in the Federal government, stated that if it weren't for the Para Transpo System he would be home collecting a pension. Medical treatment practices were also affected. Hospitals began to release patients earlier and continued their care as outpatients thus making available more hospital beds. Educational and recreational programs for disabled persons increased greatly.

As a result of all this, in the early 1980's the service could not keep up with the demand. CUTD requested the Regional Transit authorities to review the system and to assume direct control of the bookings and dispatching. Thus in 1983 a Para Transpo Review Committee was set up, with CUTD representation to review the system and make recommendations for change. Thirteen recommendations for improvement were brought forward and accepted by the Regional government, the major one being the takeover of bookings and dispatching by OC Transpo in November 1985.

CUTD contines to play an important role in providing information to the community and contributing to public awareness. In the early years of Para Transpo there was some dissatisfaction with the service and many complaints were voiced. CUTD decided it would be timely to hold a public meeting, an Information Night, to which the public and consumers were invited to bring their questions and concerns before the providers of the service. In this way both sides were made aware of problems each faced and more knowledge about the system was gained.

CUTD is an ongoing resource for public awareness. Frequently, some Committee members act as speakers to interested groups or serve as panellists at conferences and meetings.

CUTD provides a link between the consumers and providers of the service. Individuals or groups who have not been able to resolve their transportation problems directly with Para Transpo turn to the Committee for assistance. These are dealt with at Committee meetings which the head of Para Transpo services attends on a regular basis. He in turn asks for input on policies and practices and uses the Committee as a sounding board and for advice.

The Committee maintains a close liaison with government and transportation authorities. When a subject concerning Para Transpo is on the agenda at public Regional Transit Commission meetings, CUTD is informed and has representatives present to speak if necessary. It also serves as a resource and advisor for government transportation authorities. On occasion politicians are lobbied before policy decisions are voted on.

4. FUTURE GOALS

Besides its ongoing role of monitoring the service, promoting public awareness, acting as a resource for transportation authorities and providing a link between the consumers and deliverers of the service, the Committee still has some practical goals to achieve.

A. CUTD will continue to lobby for a more complete service. At present the service is limited because of costs and cannot meet the full demand.

B. CUTD will be working for a fairer fare structure. Presently the fare is equivalent to the most expensive (premium) fare on the regular OC Transpo system.

C. Service on demand instead of booking a day in advance is another CUTD target. Para Transpo will then be able to offer the freedom and spontaneity of mobility available on OC Transpo.

When the Para Transpo system becomes as similar in design as possible to the regular bus system the concept of a parallel service will then be realized.

5. CONCLUSION

CUTD has been in existence for fourteen years and has held over one hundred meetings. Four of the five original founding members are still actively involved. The Committee membership now numbers twelve people, half of whom are persons with physical disabilities. It is deemed desirable to have a mixture of disabled and non-disabled persons to provide a broad community representation. In this way the interests of the overall community are reflected.

The Committee, while originally under the auspices of the Social Planning Council of Ottawa-Carleton, has operated for the past ten years as a committee of the Rehabilitation Institute of Ottawa-Carleton, another United Way funded organization with many volunteers devoted to the improvement of conditions for disabled people in the community.

The achievements of CUTD in the development and establishment of a specialized door-to-door transportation system for physically disabled persons who cannot board the regular buses, demonstrates how a volunteer group of concerned citizens can effect change, and bring about better conditions in the community for people with physical disabilities.

FOOTNOTES

1. Ottawa Carleton Bus Transit Development Study - Phase II - DeLeuw Cather and Company.

2. Directory of the Disabled - Graduate School of Social Work - Carleton University, Ottawa, Ontario.

3. Canadian Standards Assoc. CAN3-D409-M84
Motor Vehicles for the Transportation of Physically Disabled Persons
Vehicular Transport
A National Standard of Canada

YEAR	REGISTRATION	VEHICLES (IN PEAK HOURS)	DAYS/HOURS	TRIP PURPOSE	FARE	PASSES	COST
Aug. 1974		12 cars 2 vans	Mon. - Fri. 7am - 5pm	Work, Medical, Post Secondary	.50		$143,050
1975		10 cars 3 vans	Mon. - Fri. 8am - 6pm	Work, Medical, Post Secondary	.50		$224,283
1976	800	13 cars 3 vans	Mon. - Fri. 7am - 7pm	Work, Medical, Post Secondary, Recreation if Room	.50		$269,268
1977	1783	14 cars 8 vans	Mon. - Fri. 7am - 7pm	From February All Trip Purposes	.50		$368,215
1978	2000	14 cars 8 vans	From October Mon. - Fri. 7am - 12md. Sat. & Sun. 9am - 12md.	All Trip Purposes	.50 October .75		$498,074
1979	2500	16 cars 11 vans	Same as Above	All Trip Purposes	.75		$668,298
1980		19 cars 14 vans	Same as Above	All Trip Purposes	.85		$806,485
1981		20 cars 12 vans	Same as Above	All Trip Purposes	.90/.95	$26/month	$1,161,747
1982		25 cars 15 vans	Same as Above	All Trip Purposes	$1.05 $1.10	$32/month	$1,552,595
1983		27 cars 17 vans	Same as Above	All Trip Purposes	$1.15	$32/month $34/month	$1,785,990
1984	7500	12 cars 23 vans	Same as Above	All Trip Purposes	$1.20	$36.50/month	$1,958,800
1985	8000	14 cars 24 vans	Same as Above	All Trip Purposes	$1.45	$40/month	$2,640,610
1986	9900	10 cars 34 vans	Same as Above	All Trip Purposes	$1.60	$44/month	$3,600,000

CURRENT POLICY IMPLEMENTATION ACTIVITIES IN CANADA

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CURRENT POLICY IMPLEMENTATION ACTIVITIES IN CANADA

1. INTRODUCTION

The purpose of this paper is to present current policy in Canada regarding transportation of disabled persons and to highlight current policy implementation activities in Canada related to national transportation modes of transportation, air, rail, marine and intercity bus. A central theme of the paper will be to emphasize the roles of the various actors involved and their evaluation.

2. POLICY STATEMENT

It is the policy of the Government of Canada to ensure that all persons have access to a safe, economic, efficient and adequate transportation system, and that each carrier or mode of transportation, so far as is practicable, carries traffic to or from any point in Canada under rates or conditions that do not constitute an undue obstacle to the mobility of persons.

3. LEGISLATIVE FOUNDATION

This policy statement has as its legal basis Section 15 of the Canadian Charter of Rights and Freedoms and Sections 15.1 of the Canadian Human Rights Act. Section 15 (1) of the Charter states that:

"Every individual is equal before and under the law, without discrimination based on race, national or ethnic origin, colour, religion, sex, age or mental and physical disability."

Section 19.1 of the Canadian Human Rights Act empowers the Governor in Council to make regulations prescribing standards of accessibility to services, facilities or premises, for the benefit of having any disability, while Section 15.1 stipulates that:

" a person who proposes to implement a plan for adapting any services, facilities, premises, equipment or operation to meet the needs of persons arising from a disability may apply to the Commission for approval of the plan."

The federal Minister of Transport has the authority under the Canadian Human Rights Act, the Ferries Act, the Canadian Shipping Act, the Transport Act, the National Transportation Act, the Railway Act and the Aeronautics Act to establish standards for accessibility by disabled people to facilities and services under federal jurisdiction.

4. MINISTER OF TRANSPORT CANADA'S TDPIC (TRANSPORTATION OF DISABLED PERSON'S IMPLEMENTATION COMMITTEE)

The federal Minister of Transport has established the TDPIC, which reports through the Chairman to the Minister of State (Transport Canada). The following are the TDPIC's objectives:

a) To develop measures designed to improve access to the national transportation system consistent with the Minister's statutory and other obligations.

b) To provide an active forum where government policy makers and officials, representatives of the transportation industry and representatives of transportation disadvantaged persons and groups can meet and develop a broad implementation strategy and specific modal plans for achieving a reasonable level of accessibility for disabled persons to the national transport system.

c) To assess new technology, public education and other service solutions to see how they are working and what further improvements can be made.

d) To consider and advise on matters referred to the Committee by the Minister.

The establishment of the TDPIC is a bold step in that its composition includes representatives from the major disabled consumer organizations:

a) The Coalition of Provincial Organizations of the Handicapped (COPOH).

b) The Canadian National Institute for the Blind (CNIB).

c) The Canadian Association for Community Living (CACL).

d) The Canadian Coordinating Council on Deafness (CCCD).

e) The Canadian Association of the Deaf (CAD).

f) The Blind Organization of Ontario with Self-Help Tactics (BOOST).

transport service providers:

a) VIA Rail.

b) Air Transport Association of Canada (ATAC).

c) Canadian Bus Association (CBA).

d) CN Marine.

and government agency representatives:

a) The Canadian Human Rights Commission (CHRC).

b) Canadian Conference of Motor Transport Administrators (CCMTA).

c) Airport Authorities Group (AAG).

chaired by an independent chairman. TDPIC members were appointed by the Minister. Members are paid an honorarium and for travel expenses unless their line of work is directly related to this area.

The boldness of the TDPIC is that normally such groups individually or collectively lobby government(s) to ensure their interests are achieved, often without the benefit of dialogue with each other.

The Minister of Transport has requested these organizations come to the table to discuss issues together. This process allows each party to debate issues effectively and seek acceptable and practical solutions. This approach has allowed each "side" to obtain a better understanding of each other's requirements and constraints.

The TDPIC has organized Task Forces with the knowledgeable working level staff from disabled consumer organizations, transport service providers and government agencies who have hammered out short term actions and areas where further technical study is required. Task Force recommendations to the TDPIC that have been forwarded through the Chairman to the Minister for consideration.

5. FUTURE POLICY DIRECTION AND ACCESSIBILITY STANDARDS

The Minister does have the authority to establish by legislation accessibility standards in all modes of transportation as mentioned earlier. The position of the Government of Canada pertaining to accessibility standards to modes of transport (air, rail, marine, intercity bus) under federal jurisdiction is as follows.

Accessibility standards will be finalized for all federally regulated modes of transportation through close consultation with representatives of the disabled and industry with final accessibility standards being available in the summer of 1987.

"In order to ensure that these standards are seen to form the basis for the provision of non-discriminatory services in the transport sector, the Government is prepared to enact regulations under section 19.1 of the Canadian Human Rights Act. The Minister of State for Transport, working closely with the Secretary of State and the Minister of Justice, would establish in these regulations acceptable accessibility standards based on full consultation with both disabled persons and service providers.

There would be no requirement for carriers to comply with regulations made under section 19.1 nor would there be sanctions for failure to comply. Sanctions would flow instead from the filing of complaints before the Canadian Human Rights Commission. However, carriers would be encouraged to comply with the regulations since, where prescribed standards were judged to have been met in the provision of a particular service, there would be no basis for a complaint regarding adequate access. Any practice found to be consistent with these regulations would be deemed to constitute a non-discriminatory practice.

In addition, the Minister of State for Transport, in conjunction with Crown corporations, will prepare adaptation plans applicable to Crown corporations, and these will be submitted to the Canadian Human Rights Commission for approval under section 15.1 of the Canadian Human Rights Act. Where a service is adapted as set out in an approved plan, there will be no basis for a complaint of discrimination in respect of that service. This procedure reflects the more active role the Government intends to take with respect to the establishment of accessibility standards applicable to Crown corporations.

The progress of carriers and operators toward compliance with these accessibility standards will be closely followed by the Government, and if there are serious problems of non-compliance after three years, the Government would force compliance through specific regulations under the appropriate legislation administered by the Department of Transport."

The following action has occurred in the development of accessibility standards.

a) Rail Mode

Accessibility standards for the rail mode have been finalized. These standards cover the areas of terminal facilities and equipment.

b) Marine Mode

Accessibility standards covering equipment have been developed for ferry services.

c) Intercity Bus Mode

Guiding principles covering terminals and equipment have been developed for intercity buses.

d) Air Mode

Accessibility standards covering service and equipment have been drafted for aircraft with more than 60 seats. Guiding principles have been developed for aircraft with 60 or less seats.

In order to ensure consistency across modes, Transport Canada is standardizing these standards where it is feasible and practicable. Once standardized, the standards will be submitted to the Department of Justice for final approval.

This policy direction reflects the federal government's commitment to improving access to transportation services for persons.

6. CURRENT INITIATIVES

The following is a list of accessibility issues taken as a result of work from the TDPIC and its Task Forces.

a) Accessibility standards for the four intercity modes are being standardized to the extent possible.

b) A mechanism for consulting with disabled consumers in the modification of terminal buildings has been developed and put into standards in the case of airport terminals.

c) Training videos for carrier personnel dealing with the publics on the topic of how to assist disabled persons are being developed.

d) Research and development projects in the area of communications equipment for sensory impaired disabled persons have been initiated.

e) Negotiations with the bus industry regarding the demonstration of an accessible bus on a major intercity route are taking place.

f) Guiding standards for accessible air transportation are being developed for aircrafts with more than 60 seats, and guiding principles are being developed for aircraft with 60 seats or less.

g) Negotiations with the Air Transport Association of Canada regarding the provision of accessible aircraft boarding devices have been initiated. Transport Canada has presented the Association with a discussion paper on this matter.

h) An action plan on how to provide accessible transportation services at airports has been developed.

i) A project to collect data on transportation barriers faced by disabled people has been initiated.

In addition Transport Canada has allocated $2.0 million annually to a Transportation of Disabled Persons Program. Plans for the following are included.

a) Development and testing of a multi-purpose vehicle capable of functioning as a paratransit vehicle, a school bus or an ambulance in rural areas.

b) Development of a suitable aircraft boarding device to transfer wheelchair-bound passengers between terminal buildings and aircraft.

c) The evaluation of a station-based intercity bus transfer chair that allows physically disabled bus travellers to transfer from a wheelchair into a bus by means of a chair that goes up and down a screw thread.

d) The design and development of a computerized vehicle dispatching system for both paratransit and regular vehicles that would allow for better integration of the various transportation services available in large cities.

e) The design, development and testing of a communication center for terminals.

f) A vehicle acquisition program which provides up to 80% of the purchase price of vehicles equipped to transport disabled persons in small urban or rural communities.

g) Assistance to intercity bus operators for the installation of an hydraulic lift in intercity buses.

h) Integration of accessible taxis into the taxi fleet, to demonstrate the suitability of using accessible taxis on a commercial basis to transport disabled people within an urban environment, by making available an 'on-demand' service to those who are not eligible for para-transit service, or who prefer the flexibility offered by taxi service.

i) Incorporation of an hydraulic lift in a second intercity bus and demonstrate it across Canada and at the EXPO 86 site during the summer of 1986.

j) Acquisition and compilation of information on transportation services and facilities available to disabled travellers.

k) Sponsorship of the Fourth International Conference on Mobility and Transport for Elderly and Disabled Persons to be held in Vancouver in July, 1986.

7. CONCLUSION

In 1981 I presented a paper to the Mobility Conference held in England. In that paper I noted:

"Roles for the federal government include the final development and approval of a policy governing transportation services under federal jurisdiction ... in conjunction with the expected amendments to the Human Rights Legislation [which] will lead to new direction, policies and programs."

I concluded

"Transportation for the handicapped has seen major developments in the 1970's and it would appear that the 1980's will also see significant development. The key to successful future development will be an awareness of current and future issues and the coordination of efforts by government, consumers and service operators."

I believe that the development of transportation for the disabled at the national level is evolving in the right direction through this coordination effort and this conclusion is as valid today as it was in 1981.

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ACCESSIBLE TRANSPORT & THE OPPOSITION

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ACCESSIBLE TRANSPORT & THE OPPOSITION

by Russell Hunt - Disabled Peoples' International

Through a process of social and economic evolution, societies progressively develop responses for coping with their members who are disabled. Where the economics of existence dictates the need for "Survival of the fittest", many People with disabilities simply die. However, as the economic climate improves survival is possible but social evolution will define the quality of this existence.

Within most Western societies this evolution developed into a perceived need to "care for" People with disabilities. Such work became an issue of social status and praise usually done by groups of wealthy people purely because those on a more meagre income never had the resources or the time for such work. These activities developed into the well known pastime of charity for the disabled. It went well beyond the simple care offered to a loved one and resulted in the development of two fundamental attitudes which have profound implications. They are:

- The creation of paternalistic views towards "The disabled";
- The development of a segregated mentality towards disability.

This **Paternalism** is the inevitable result of a "Charity Ethic", where one group of people is eternally placed in a position of power over another. The tool for exercising this power is infact the care that is given. It makes the recipient a "Captive of the Care System" because the user has had no option but to comply with its rules or be denied the service. A service which may even mean the difference between life and death. When one considers the essential nature of such services and the past absence of alternatives, the overt power of this captivity is immense. The covert power of the care system is possibly even stronger because of the frequent good intentions of the care giver. How ungrateful and dangerous it would be for the recipient to question their actions or motivations!

The **Segregation** of disability is the logical consequence of such charitable paternalism. Firstly, how can we treat People with disabilities as integrated equals if they are always related to as receivers of our care? Secondly, there needs to be definite evidence of charitable activity so that it can continue to attract the social and economic support required to sustain it. For example, a segregated school for disabled children is far more visible, and therefore a better charitable marketing device, than an integrated education system.

By now you may be wondering what these concepts have to do with the issue of accessible transport. Traditionally we have approached the issue by looking at the economic, engineering and moral issues in favor of accessible transport. These are vital topics, however I wish to look at the specific forces working against our quest for transport equality.

I put it to you that the concepts of paternalism, the charity ethic and the resultant process of segregation actively mitigate against the development of accessible transport. Infact, the absence of such transport is a fundamental mechanism for maintaining the status quo which makes People with disabilities the captives of care! I would assert that;

"The denial of the means to easily move from one point to another is as effective as the Jailers cell in maintaining that captivity."

ACCESSIBLE TRANSPORT & THE OPPOSITION

However, the ramifications of restricting the mobility of People with disabilities goes well beyond the obvious physical issues. The captivity of the charitable care system has its most insidious effect by restricting exposure to the general society. George Orwell's Thought Police knew that for the State to maintain power, the individual must not be exposed to new uncontrolled situations. The regimented environment of traditional segregated disability services operates in the same way. The myth of the essential need for such institutions is threatened if the Person with a disability is able to easily travel beyond its sphere of influence. It would expose the individual to new experiences and ideas that could erode the climate of dependency prevailing within the institutional system. It would also demonstrate that there is life beyond the institution and encourage the person to challenge their social captivity!

On a larger scale, the entire social view that People with disabilities were different could be shown to be ridiculous if they got out! What would happen to the myth of difference if they displayed normal behavior and aspirations? The multi-million dollar disability industry could be undermined. It markets its segregated facilities in a community believing that People with disabilities can't function outside of such a climate. Huge numbers of welfare professionals could become redundant if the system breaks down. However, the most fundamental shock would be to our social conscience which has wallowed in its self-satisfied belief that we were adequately caring People with disabilities.

> **"It is therefore reasonable to ask ourselves if the reluctance to provide accessible transport is one of societies subconscious methods of maintaining its control over disability."**

There are also other more tangible reasons why existing charitable organisations have a vested interest in maintaining the transport status quo. Such organisations must have a highly visible reason for being so that they can continue to attract public financial support. The provision of specialised transport, with the organisations name boldly displayed on the side of the vehicle, is one of their strongest selling points. The capital and public relations investment in such segregated transport facilities is worth many millions of dollars and well is worth protecting.

Some would say that such views seem paranoid and conspiratorial. However, when one analyses the fragile arguments against accessible transport you begin to wonder what the opposition is all about. For instance:

- The economic case is weak when you realise that the cost of accessibility at the time of construction is an insignificant component of the total budget;
- Some say with "I told you so" satisfaction that People with disabilities don't use the facilities when they are available. However when a taxi subsidy scheme was introduced in my home state it immediately generated four times the predicted usage;
- There is also the view that there aren't enough People with disabilities to justify the expense. Yet there are over 400 Million of us throughout the world and that number is rapidly increasing due to aging populations and advances in medical science. Not to mention the fact that accessible transport is useful to us all. Have you ever used a bus whilst pushing a child in a pram?

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I do not suggest that conscious plots are developed to oppress People with disabilities. I also acknowledge the vast pool of genuine good will that prevails towards disability within the community. Yet goodwill when matched with lack of knowledge and inaccurate preconceptions can still be fatal. Consider, if you will, the fate of a butterfly when a child picks it up to look at it. Despite the good intentions, the outcome is often terminal.

The barriers towards vital issues such as accessible transport are undoubtedly the paternalism and segregated attitudes of the community towards People with disabilities. They are motivated by resistance to change, protection of vested interests and the need to vindicate past actions by retaining the beliefs upon which they were based.

Disability activists have long ago occupied the high moral ground regarding the need for accessible transport. However, despite a few notable exceptions, there has been little fundamental change in community actions. We also see our colleagues from developing countries falling victim to the same problems as their countries develop their transport infrastructures along traditional lines.

> **"The time has come for us to concentrate on the attitudes and institutions within society that have vested, attitudinal and historical interest in opposing accessible transport for People with disabilities."**

THE RIGHT OF THE ELDERLY AND DISABLED PEOPLE TO ACCESS TRANSPORT AND MOBILITY

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THE RIGHT OF THE ELDERLY AND DISABLED PEOPLE TO ACCESS TO TRANSPORT AND MOBILITY - ROLE OF ADVOCACY AND CONSUMERISM: BY JOSHUA T. MALINGA - DEPUTY CHAIRPERSON OF DISABLED PEOPLES' INTERNATIONAL

Presented To: The Fourth International Conference on Mobility and Transport for Elderly and Disabled Persons in Vancouver, Canada
July 21 - 23, 1986

When writing this paper many issues and ideas came in my mind and the first one is who are these panelists and then this is what I am querying about them:

1. Noble may be -

    a) a coordinator of travel agents

    b) a government employee dealing with disabled travellers

    c) a private sector travel agent specializing in accessibility

    But is he disabled and is he involved in advocacy and consumerism or is he a professional person?

2. Flanders perhaps works for the National Bus Company probably employed to deal with disability issues vis a vis buses. He may have ideas about disabled bus users' needs. He may not be able to promote a really need for bus conductors. I ended up asking the same question as above.

3. Clark - may be employed in a similar capacity as Flanders - or he may be a blind person brought in to give the benefit of his experiences on the needs of blind people and the elderly on transport.

    I also ended up by asking the same question as of Noble and Flanders.

4. Finlay may belong to the Volunteer Advocacy Committee and may go around unearthing structural and physical problems in the urban transport system. Maybe by using surveys and researches. The same question as above was asked.

I then finally thought that these other panelists are probably "experts" and those of us who have been "invited" are supposed to have input as persons with disabilities and I therefore resolved that perhaps. What is required of us is to listen with a "third eye" and raise points neglected by the four "experts" and as somebody from the developing world and also because I travel a great deal sometimes, I thought it would be interesting to you if I told you about my experiences and also what disabled people themselves have done in Zimbabwe.

I grew up in a rural home and I did not go to school until I was twelve years old and I did not have the benefit of appliances until I was fourteen years. In fact, I did not know about appliances at all and I was crawling on all fours for all these years. The same story is echoed by many of my disabled colleagues.

Because like all boys in my village I was required to look after cattle and goats and also to go to the fields to chase after wild animals and birds so that they do not eat crops - I was on the move all the time, I developed hard "layers" on my hands, knees and toes. Sometimes I used a donkey, a sledge or scotch cart and you will be surprised that these forms of transport are still very much in use in my country even today by disabled, elderly and the general public.

I can tell you a number of interesting stories about these types of transport and the dangers I experienced when using them. One day - a donkey just decided to go into a thorny bush and you can imagine what happened! I was left there and somebody had to come to my rescue. Another day, donkeys just decided to go wild and the scotch cart overturned with me inside and I just do not know how I survived. One day also - oxen after being strike by one of my brothers left the road and the sledge was torn to pieces while I was inside. By the way - I had forgotten that one of my most convenient and most reliable forms of mobility and transport was to be carried by my mother, my sisters and brothers on their backs.

But as I said, I did not go to school because of problems of mobility and transport, I had to be sent to an institution for my education and training and it is at this place when I and other disabled banded together to form an organization of consumers to address this and many other issues of concern to the disabled and elderly.

We started off by approaching bus companies telling them about bad treatment from their drivers and conductors and also about problems of querying and having to rush to enter the bus. The response was very good and these are the concessions that we got:

1. We were invited to have an in-put in the training of bus drivers and conductors and we were surprised how much they did not know about disabled people.

2. The first two seats of a bus in Zimbabwe are now reserved for the elderly and disabled people.

3. Disabled people are not required to queue for the purchasing of tickets and they stand in front of every queue.

4. Blind people do not pay any bus fares even to privately owned companies.

Our approaches to the Railways of Zimbabwe resulted in the following concessions too:

At Heathrow airport, the chairs do not have "push rings" which you can use to wheel yourself around and when I asked why - I was told that disabled passengers move around too much and dissapear and that they had to be kept in one place and would be assisted if they wanted to go somewhere. This is all inhumane and blantant denial of freedom to privacy and the right to freely associate with other people. And most of the time when you asked for somebody to come and assist they were not available. They were too busy assisting other disabled passengers. These are just a few cases I am able to cite in this brief presentation and something has to stop this type of treatment.

In conclusion, in all these cases it is clear that disabled people were not consulted at all and that they did not take part in the decisions. What is clear therefore is that we should, as disabled people be responsible for making these decisions and designs. People should not think for us. We are grown ups and we are best able to interpret our problems because only us know what it is to have these disabilities and we experience them everyday and they are not imaginary - they are real and with us.

For those of us from the developing world, it is important to point out that you are speaking of people with no income and cannot afford any appliance what soever. Mos t of the appliances we get from other countries are not good for our terrain and cannot be repaired. We need some of appropriate technology to produce affordable and suitable appliances. You cannot dny us just the right to be mobile while you enjoy the trudge of your good legs and enjoy all other forms of transport. It is also important to note that no country can afford two forms of transport - one for the disabled and another for able bodied. It is therefore incumbent upon the planners to take our special needs into account when planning all forms of transport. Disabled people have been told many times that there are no resources and that they should wait and what that means is they should wait until everybody else is so rich that they will not no tice the sacrifice and how long is that? Personally, I know that I will not live to be 100 years old or even sixty. So I am being told that what others take for granted I will not have until I am dead. Disabled people are not longer prepared for this.

We demand this facility as a matter of right and we are prepared to fight for accessible transport on the land, on the sea and in the air and nothing will stop this revolution.

I must congratulate the organizers of this conference for inviting true representatives of the disabled people and I would hope that in future other conference organizers would include disabled people in the whole process of planning, organization and implementation. In other words, the disabled people must provide the leadership and run the conference. This conference and the others to follow will never be the same because disabled people do not want just to talk - they want action.

I have just tried to look through the reports of the previous conferences and this is the fourth and the question I am asking is what practical steps were taken after those conferences other than making preparations for the next conference. After every conference, there must be a plan of action targetted to solve practical problems faced by the disabled people in their day to day activities concerning transport and mobility and we must not forget the answer to these problems lies squarely in the hands of those who are directly affected - the disabled people and the elderly.

I want to end up by telling you that I have a brother who is a salesman and he always reminds me that in Salesmanship - "The customer is always right" and I dare say - in consumberism - "The consumer is always right".

4.0 PRIVATE TRANSPORTATION

A STUDY OF THE CAR CONTROL AND SEATING REQUIREMENTS OF 908 DISABLED PEOPLE ASSESSED BY THE BANSTEAD PLACE MOBILITY CENTRE BETWEEN MAY 1982 AND APRIL 1985

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A STUDY OF THE CAR CONTROL AND SEATING REQUIREMENTS OF 908 DISABLED PEOPLE ASSESSED BY THE BANSTEAD PLACE MOBILITY CENTRE BETWEEN MAY 1982 AND APRIL 1985

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1. INTRODUCTION

Banstead Place Mobility Centre is part of Queen Elizabeth's Foundation for the Disabled, which is a registered charity operating four units in the United Kingdom. The Mobility Centre was opened in May 1982 "to assist disabled people to achieve an optimum level of safe outdoor mobility which would enrich the quality of their working and social life". Assessments are offered to disabled people of all ages and disabilities who wish to learn to drive a car for the first time or who wish to continue or return to driving having acquired a disability.

At Banstead all drivers are divided into two groups: those who have a purely physical disability, however severe, who wish to know how to modify the car controls in order to compensate for their lack of physical ability, and those whose disability arises as a result of organic brain damage. The first group are seen by a therapist and driving instructor, but the second group, which includes people who have had a stroke, head injury, cerebral palsy or spina bifida with hydrocephalus, attend for a whole day. These people need to know whether they are medically fit to drive, whether their vision is adequate, whether they can perceive and respond appropriately and quickly in busy traffic situations, in addition to knowing how to modify the car controls to meet their physical needs. This driving ability group are seen by a doctor, an orthoptist, a psychologist, a therapist and a driving instructor.

Between May 1982 and April 1985, 908 disabled people were seen, either at Banstead or on a Mobile Unit which tours the U.K., for car adaptation or driving ability assessments. The purpose of this study is to consider the physical requirements of disabled drivers and therefore clients from both types of assessments are appropriate and have been included in the study. Each client's details were recorded at the time of the assessment, and this data has been extracted retrospectively from the reports in their files. As a pilot centre, it was thought vital to monitor each client's progress following assessment and follow up work is in progress. Clients are first re-contacted one year after assessment and at intervals during their first three years of motoring or returning to motoring. Ultimately it is our intention to compare their choice of car controls with those recommended at the time of assessment. To date, for two reasons, this has only been possible with a small sample group of clients. Firstly, when the centre opened in 1982 the number of assessments completed was small and therefore only a small number of clients have been on the road for more than a year or two. Secondly, all the current follow-up work and this study have been carried out without a grant.

Providing sufficient funding can be found, a sizeable longitudinal study will be possible over the next few years.

For the above reasons this study has to be regarded as a first phase. It has been possible to identify and describe the patterns of controls recommended for certain disability groups. However, until these people become drivers and we can observe their safety record and the types of controls which they use, we shall not be able to confirm the appropriateness, or otherwise, of our recommendations.

2. GENERAL DATA

Disability group and sexes

The clients were subdivided into 18 disability groups as follows:

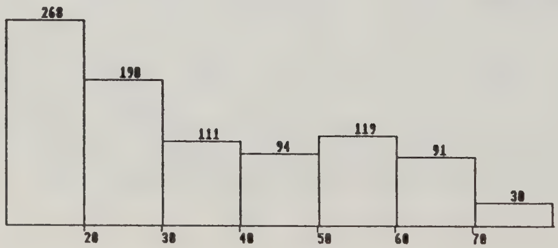
	Male	Female	Total
Left hemiplegia	65	12	
			141
Right hemiplegia	52	12	
Spina bifida with hydrocephalus	66	54	120
Cerebral palsy	59	54	113
Arthritis (Rheumatoid & degenerative)	15	68	83
Spinal injuries	47	23	70
Multiple sclerosis	31	36	67
Myopathies	44	19	63
Congenital limb deformity	21	31	52
Acquired limb deformity	23	13	36
Diffuse brain damage	26	10	36
Neuropathies	21	10	31
Poliomyelitis	10	18	28
Head injuries	15	5	20
Spina bifida (2)	9	9	18
Other	8	8	16
Friedreich's ataxia	7	4	11
Hydrocephalus	3	0	3
	522	**386**	**908**
	57.49%	**42.51%**	

Ages

Ages were grouped in decades. The youngest clients were 15½ years old.

Numbers of clients

(Total 908)



Ages of clients

Clients' ages were then considered in relation to their disability group and sex.

It was noted that there are more male hemiplegics than female with a predominance of men in their 50s and 60s, whereas there are more female arthritics, with the first peak of under 20s who have juvenile arthritis, then the second peak of ladies in their 50s including some with degenerative joint disease. It is also noted that the cerebral palsy and spina bifida groups are mainly first time drivers in their teens or 20s. The spinal injuries and head injuries groups contain a lot of young men in their 20s and most myopathies are teenage boys. These findings indicate that this subject group of 908 people contains appropriate representatives of each disability group.

3. ANTHROPOMETRIC DATA

Stature:

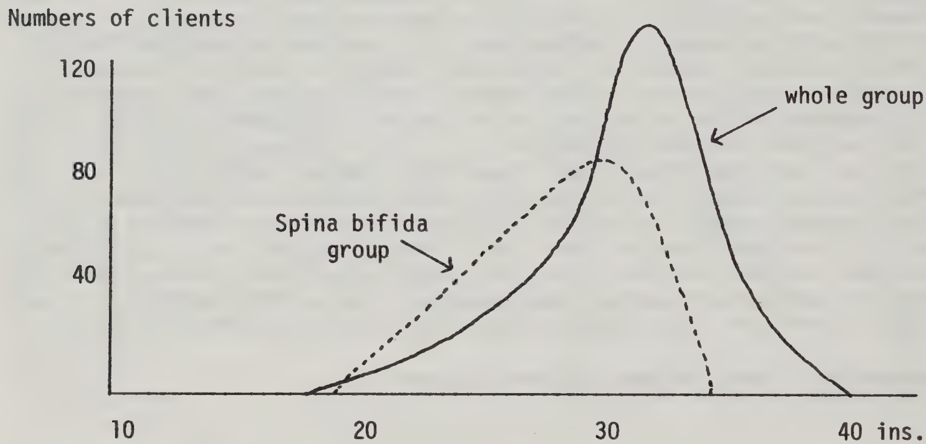
All measurements were taken in feet and inches. The smallest person in the whole group was 2'8" tall and the two tallest men were 6'6". Height measurements were grouped into six-inch categories and the number of clients in each category expressed as percentages. It has been noted that the group as a whole contains a number of people who have been disabled from birth or early childhood which has restricted their skeletal growth, and therefore the overall percentages show a greater proportion in the shorter stature groups than for an able bodied population.(1) The following table shows, as anticipated, that the congenital disability groups contain the greatest proportion of people with reduced stature, and that the male dominated groups who have acquired disability in adult life have a greater proportion of tall people. It had been thought that the clients' stature and sitting height would relate to the need for a seating modification. It now appears that stature does not affect seating requirements; the sitting height is a much more useful predictor and stature relates only to entry and exit of the car.

Percentages of clients in each stature category (3)

	$<$4'6"	4'7"-5'0"	5'1"-5'6"	5'7"-6'0"	$>$6'0"
General Group	**8**	**16**	**37**	**34**	**5**
Congen. Limb Def.	51	23	21	5	0
SBH & Spina Bifida	28	41	22	7	2
Poliomyelitis	5	41	36	18	0
Arthritis	5	24	50	20	1
Cerebral Palsy	3	23	57	17	0
Acquired Limb Def.	3	6	48	37	6
Myopathies	2	14	45	35	4
Left & Right Hemi.	0	2	26	66	6
Multiple Sclerosis	0	2	45	45	8
Neuropathies	0	10	38	42	10
Spinal injuries	0	3	33	55	9
Diffuse brain damage	0	3	34	52	11
Head injuries	0	0	20	70	10

Sitting height:

This measurement was taken in inches with the client sitting as they would for driving. Some clients, due to weakness of the trunk muscles or flexor spasticity, sit with a stoop and in these cases their effective sitting height was reduced. Other clients, notably the spina bifida group, had a marked spinal deformity. The lowest sitting height recorded was 17" and the highest 40". 60% of the group had a sitting height between 29 and 33 inches and these people generally had no access or seating problems. The 16% who had longer backs were mainly people who acquired disability in adult life and, as for overall height, they were the male dominated disability groups. Some of these people had access and comfort problems. 24% of the total group had a sitting height of less than 28". This is a greater proportion than that found in an able bodied population (1). The outstanding group was the spina bifida group where 21% measured less than 24". These people needed seating modification as shown later.



Distribution of sitting heights

Finger tip reach:

Each client is asked to reach forward as if to touch dashboard controls. The measurement for each arm was recorded in inches. Sometimes the reach was reduced because of restricted growth in those with congenital limb abnormalities; more frequently it was limited by reduced joint function and pain as in arthritics. It was also noted that 36% of those with right hemiplegia had no functional reach in their affected arm, whereas 56% of those with left hemiplegia had no residual function. Lack of muscle power and contractures affected a few people with polio.

Considering the whole group, and discounting those who had no function in the arm, only 1% of the people had a reach of less than 10", and these were mainly congenital limb abnormalities. Most of the 14% of the people with a reach between 11"-23" had arthritis and needed some controls modified. 75% of the whole group had a reach between 24" and 30" and these people, together with the 10% who had long arms, had no difficulties reaching dashboard controls.

4. MEASUREMENTS OF STRENGTH

Brake Pressure

Three pieces of equipment were used to measure braking strength; the original static unit measures in increments of 10 lbs up to a maximum of 60 lbs; the second computerised unit measures in single pounds up to a stop at 140 lbs. Both these machines are able to measure hand or foot braking. The third device is an automobile industry pressometer which is used occasionally to measure clients with very reduced stature or those using other parts of the anatomy, such as knees and elbows. In all cases the clients are asked to repeat the test, using the appropriate limb, at least three times and, where early fatigue can be expected, a greater number of times. Then an average is recorded. Measurements from the pressometer were not used in this study, and those from the first and second machines were considered separately.

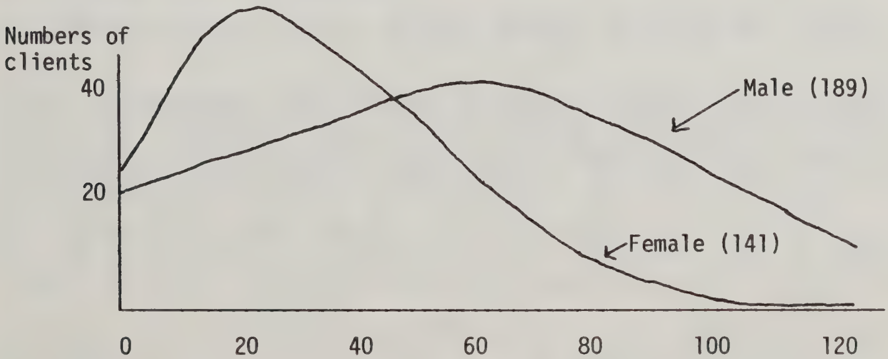
Numbers of clients tested on each piece of equipment

	Male	Female	Totals
Original static unit	290	219	509
Computerised unit	189	141	330
(Pressometer)	43	26	69
Totals	522	386	908

Although each unit had a different maximum, it was noted that the strength of female clients tailed off before that of the males, and on the computerised unit only one lady recorded 120 lbs. On the computerised unit the mean for the males was 66.151 lbs and for the females 41.979 lbs.

Looking at the different disability groups it could be seen that no male client with a myopathy was able to record above 30 lbs, and that some of the male spinal injury clients were also very weak. Among the female clients some arthritics were weak and the spina bifida females were noticeably weaker than the males with the strongest female recording 50 lbs.

The strongest disability groups were the head injuries and the hemiplegics, both predominantly male groups.

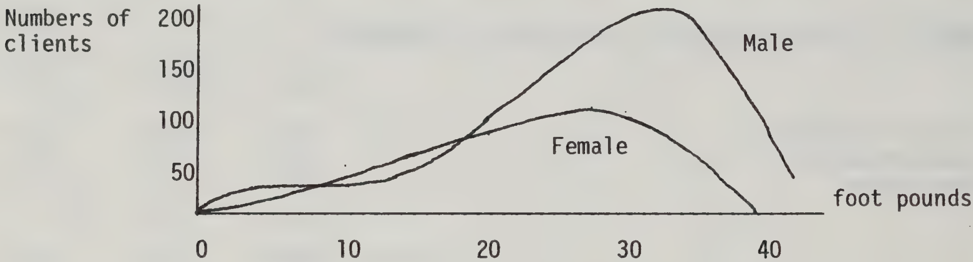


Measurement of brake pressure in lbs on computerised unit

Steering Torque

Two sets of equipment were used: the original static unit measures in foot pounds in increments of 10 up to a maximum of 30 and the computerised unit housed in the Mobile van measures in pounds inches in increments of 1. The two sets of measurements were again considered separately, with 57% of the clients being measured on the older static unit.

The technique employed for measuring is the same on either piece of equipment. The client is asked to use the appropriate hand or hands to turn the wheel against resistance in both clockwise and anticlockwise directions. If only one hand is to be used measurements are taken, using a steering aid, at 4 points (North, East, South and West). On the older unit the readings are noted on paper, but on the computerised unit a list, together with the average in each direction, is printed.



Torque measurements of 514 clients on static unit

Throughout the steering measurement tests on either machine, the females recorded lower readings than the males. On the computerised unit 190 males and 146 females were tested. The results, in pounds inches, were as follows:

To show comparative strength of male and female clients tested

	Clockwise				Anticlockwise			
	Mean	Median	Min.	Max.	Mean	Median	Min.	Max.
Male	141.91	149.00	7.00	350.00	141.22	149.00	7.00	291.00
Female	127.98	128.00	0.00	348.00	129.29	135.00	0.00	294.00

Each disability group was then considered against these measurements. Some groups such as arthritics, myopathies and spinal injuries (4) showed widespread reduction in strength, whereas some of the young spina bifida and cerebral palsy clients had low readings whilst others in their groups were adequate. Readings varied in the congenital limb deformity and poliomyelitis groups, some being very low. There was one lady with multiple sclerosis who only recorded 35 lbs, and another with left hemiplegia recording 42 lbs, and these would not have been anticipated from looking at their groups as a whole.

The steering measurements were also considered in relation to the limb being used. It was surprising to note that of 908 clients, only one was steering with a foot and she was a lady with polio using her left foot. A few of the congenital limb abnormalities were using parts of the upper limb and, in one case, a shoulder.

There were no apparent differences in steering strength dependent upon which limb was being used. In some groups a usual pattern did emerge: 83% of arthritics were steering with both hands; 83% of left hemiplegics were steering with their right hand only and 82% of right hemiplegics were steering with their left hand only. With some disability groups there was a mixture of right hand, left hand and both hands, for example 3% of the spina bifida group could use foot pedals so had two hands available to steer, 3% had to steer right handed leaving the left hand to accelerate and brake, but 94% used conventional left hand steering, right hand accelerating and braking. The cerebral palsy group was also a mixture but 11% used two hands to steer, 15% the right hand and 74% the left hand.

Table to show which limb was used for steering on the Static Unit

	Right hand	Left hand	Both
Arthritis	3 (7%)	4 (10%)	34 (83%)
Acquired limb deformity	5 (26%)	3 (16%)	11 (58%)
Congenital limb deformity	4 (14%)	7 (23%)	19 (63%)
Cerebral palsy	11 (15%)	54 (74%)	8 (11%)
Diffuse brain damage	5 (24%)	8 (38%)	8 (38%)
Friedreich's ataxia	1 (13%)	6 (74%)	1 (13%)
Hydrocephalus	-	1 (33%)	2 (67%)
Head injuries	6 (43%)	7 (50%)	1 (7%)
Left hemiplegia	40 (83%)	-	8 (17%)
Myopathies	5 (21%)	6 (25%)	13 (54%)
Multiple sclerosis	2 (6%)	24 (73%)	7 (21%)
Neuropathies	1 (5%)	10 (56%)	7 (39%)
Others	1 (10%)	2 (20%)	7 (70%)
Poliomyelitis (1 used left foot)	3 (23%)	4 (31%)	6 (46%)
Right hemiplegia	-	32 (82%)	7 (18%)
Spina bifida with hydrocephalus	3 (3%)	98 (94%)	3 (3%)
Spinal injuries	3 (10%)	23 (74%)	5 (16%)
	93	289	147

5. MODIFICATION REQUIREMENTS

The 908 drivers assessed had very widely varying physical abilities. At one end of the scale 23 people (2.5%) were able to drive an unmodified manual gearbox car. At the other end 19 people (2.2%) were too physically disabled to be able to control a car with the technology existing at the time of their assessment. Recent steering developments have allowed some of these people to take up driving in the last year or so. This group contained 10 people with a myopathy and 5 people with cerebral palsy.

The three main areas of modification studied are:

Seating
Steering
Acceleration and Braking

Seating

Any driver requires a good sitting position in order to drive in comfort and in safety. This is particularly important to disabled drivers, many of whom do not have "normal" skeletal measurements or trunk musculature. Of the 908 clients seen at Banstead, some form of seating modification was required by 408 of them (45%). Some clients needed more than one modification.

240 Seat raise
180 Seat tilt
142 Side supports
98 Neck rest
180 Additional or alternative harnessing
53 A special seat
20 To drive from a wheelchair

The following table gives details of the seating modifications required by each disability group (3).

	MEAN			PERCENTAGE NEEDING SEATING MODIFICATION				
	SITTING HEIGHT (") FOR RAISE	RIGHT ARM REACH (") FOR TILT	LEFT ARM REACH (") FOR TILT	RAISE	TILT	SIDE SUPPORT	NECK	HARNESS
GROUP NOT REQUIRING ADAPTATION	31.41	27.05	27.18	-	-	-	-	-
Spina bifida with/without hydrocephalus	25.88	26.05	26.15	75	43	31	6	33
Congenital limb deformity	26.82	18.27	18.95	54	44	10	8	29
Arthritis	28.60	21.00	21.33	30	25	13	41	7
Poliomyelitis	26.28	21.00	19.83	25	25	25	18	29
Cerebral palsy	29.04	26.25	26.75	19	24	15	3	22
Myopathy	30.00	25.10	25.50	19	16	25	17	32
Acquired limb deformity	32.16	26.00	27.00	17	11	-	6	8
Neuropathy	27.25	29.00	29.66	13	10	13	6	19
Multiple sclerosis	30.28	27.61	27.50	10	19	13	7	9
Spinal injuries	27.40	26.81	24.81	7	16	39	27	53
Diffuse brain damage	30.00	29.00	29.00	3	3	-	6	6
Left hemiplegia	30.00	28.72	27.41	3	-	-	-	-
Right hemiplegia	28.00	27.93	29.15	2	-	-	2	2
Head injuries	32.90	27.43	28.58	-	-	-	-	-

Seat Raise

From this table it can be seen that there is a link between the sitting height and the need for a seat raise; as the height increases so the percentage of clients requiring a seat raise drops. Analysis also showed widely varying sitting heights within the disability groups needing a high percentage of seat raise.

	Mean	Standard deviation	Min. height	Max. height
Spina bifida	25.887	3.287	18"	36"
Congenital limb def.	26.821	3.888	17"	39"
Arthritis	28.600	3.014	22"	37"
Poliomyelitis	26.286	2.812	22"	34"

Seat Tilt

It can be seen that there is a general link between seat tilt and arm reach. Providing the driver does not have too tall a back, it is possible to partially compensate for restricted elbow extension and shoulder elevation by "tipping" the seat forward, bringing the shoulders closer to the wheel and dashboard; this applies to the spinal injury group and some arthritics. Those with weak arms (e.g. poliomyelitis and myopathies) can also be helped. The spina bifida group do not have very short arms but, because their sitting height is considerably reduced, they need several inches of seat raise and, unless the seat cushion is tilted forwards, the thighs will become jammed under the steering wheel.

Other Seating Modifications

Side supports are recommended to help to stabilise disabled drivers who lack trunk control. An alternative is a supportive, curved seat back and or additional harnessing. An inertia reel belt may be replaced by a static belt. A racing-style harness may be fitted but this can be difficult to fit safely in some cars.

Neck restraints are recommended for two main reasons; to protect those who have weak neck muscles (e.g. poliomyelitis, myopathies), and to protect those whose necks are particularly vulnerable to damage (e.g. high spinal lesions and arthritis affecting the cervical spine).

Occasionally special seats are recommended; although expensive initially, they can be placed in a car to provide tailor-made trunk support and the optimum seating position. When the car is sold the original seat is replaced and the personal seat taken to the next vehicle. Many of the special seats listed are sliding swivel seats which not only act as a seat raise but also facilitate access and the loading of a wheelchair.

On rare occasions (20) it has been necessary to recommend that the driver stays in his wheelchair (usually because independent transfers are not possible). This group includes 8 myopathies, 5 cervical lesions and 3 poliomyelitis. In the U.K., driving from a wheelchair is rare. The only production vehicle where this occurred was the Elswick Envoy and this has now ceased production.

Steering

A range of modifications may be required to the steering system. In the Banstead study this included:

578 Steering aids
110 Tailor made power assisted steering systems
69 Reduced wheel diameter
36 Standard power assisted steering
33 Altered rake and/or length of steering column
27 Special steering systems.

Steering Aids

These include knobs, spokes, tetraplegic grips and other devices to enable the driver to steer effectively, even at low speeds, using only one hand.

578	(64%)	of the group were assessed as needing an aid
224		of these people were using one or more foot pedals
365		of these people were using hand controls
		(11 drivers were using a combination of hand and foot)

	Number of people	% of the group
Spina bifida & hydrocephalus	126	91
Right & Left hemiplegia	107	76
Cerebral palsy	78	69
Spinal injuries	59	84
Multiple sclerosis	51	76
Acquired limb deformity	21	58
Myopathies	21	33
Neuropathies	21	68
Diffuse brain damage	19	53
Arthritis	18	22
Congenital limb deformity	16	31
Poliomyelitis	15	54
Head injuries	12	60
Friedreich's ataxia	10	91
Other	3	20
Hydrocephalus	1	33

Tailor-Made Power Assisted Steering

110 people were recommended to have tailor-made power assisted steering. It was noted that of this group 75% registered less than 10 lbs on the static unit. The ratio Male: Female was 56:54. The main disabilities were:

	Number of people	% of the group
Spinal injuries	25	37
Myopathies	20	33
Arthritis	19	24
Congenital limb deformity	9	18
Cerebral palsy	9	8
Poliomyelitis	6	27

Considering the mean sitting heights (SH) and finger tip reaches (FTR) within these groups it was seen that there were no significant differences in sitting heights between clients who needed assistance and those who did not, but there were reduced finger tip measurements in the arthritics, polios and spinal injuries.

Tailor-made PAS Means:	SH	Right FTR	Left FTR
Clients not needing	30.38	26.80	26.95
needing	29.80	24.42	24.28
Arthritics not needing	30.10	24.08	24.56
needing	30.00	20.47	21.31
Poliomyelitis not needing	28.81	25.50	23.75
needing	29.00	21.80	23.66
Spinal injuries not needing	31.47	27.97	28.25
needing	31.08	25.87	25.21

Reduced Wheel Diameter

As with the tailor-made Power Assisted Steering, arm reach appeared to bear a relation to this need more than sitting height, but in the spinal injuries and myopathies there appeared no size differences between those who did and did not require a smaller wheel. 69 people were recommended to have a smaller steering wheel. These included:

	Number of people	% of the group
Arthritics	23	29
Myopathies	13	21
Congenital limb deformity	12	24
Spinal injuries	9	13
Poliomyelitis	4	17

Standard Power Assisted Steering

36 people were recommended to have a car to which power assisted steering had been added at the manufacturing stage. The ages within this group were mixed but there were 11 Males: 25 Females reflecting the generally lower torque readings of female clients. The means for the group requiring standard power assisted steering were 10 foot pounds on the static unit and 115 inch pounds on the computerised unit. Sitting height and finger tip reach did not appear to influence this option. The main groups were:

	Number of people	% of the group
Arthritics	14	20
Cerebral Palsy	4	4
Congenital limb deformity	3	6
Myopathies	3	5
Multiple Sclerosis	3	5

Altered rake or length of steering column.

Whereas there was no apparent size link among those with poliomyelitis and myopathies, arm reach was reduced amongst the arthritics and those with congenital limb deformities. 33 people needed steering column modifications, including:

	Number of people	% of the group
Arthritics	9	11
Congenital limb deformity	6	12
Myopathies	5	8
Poliomyelitis	4	17

Special Steering Systems

These include remote hydraulic steering devices, electronic remote steering as used by the thalidomide groups, and exceptionally light "proportional" steering with minimal wheel travel. 27 severely disabled people required these extremely expensive devices, and this group was made up of 14 males and 13 females, two thirds of whom were under 30 years old. Apart from the arthritics, everyone had reduced reach, and the myopathies and polios had reduced sitting stature also. The group included:

	Number of people	% of the group
Myopathies	10	16
Spinal injuries	4	6
Congenital limb deformity	4	8
Poliomyelitis	3	13
Arthritis	3	4

Acceleration & Braking

Various limb combinations are possible in order to achieve the optimum level of comfort and efficient use of the controls. The following table lists the most common options; a few unusual designs have been omitted. It can be seen that the spina bifida and spinal injuries groups nearly always use hand controls and more frequently right sided ones. The strokes, arthritics and those with limb deformities usually use foot pedals.

Table to show the limbs recommended to operate acceleration and braking in those who were recommended to drive: (5)

	R Foot Acc R Foot Br	L Foot Acc L Foot Br	R Foot Acc L Foot Br	L Foot Acc R Foot Br	R Hand Acc R Hand Br	L Hand Acc L Hand Br	Total Recommended
Arthritis	40	18	9	1	5	3	76
Acquired Limb Deformity	19	3	10	0	3	1	36
Congenital Limb Deformity	20	11	2	1	9	5	48
Cerebral Palsy	4	9	16	4	45	7	85
Diffuse Brain Damage	12	3	5	0	7	0	27
Friedreich's Ataxia	0	1	0	0	8	1	10
Hydrocephalus	1	1	0	0	1	0	3
Head Injury	3	0	4	1	4	0	12
Left Hemiplegia	58	0	1	0	0	0	59
Myopathy	11	15	1	2	14	8	51
Multiple Sclerosis	3	0	12	0	36	10	61
Neuropathy	10	1	4	0	12	2	29
Other	14	0	0	0	1	0	15
Poliomyelitis	8	0	6	3	5	3	25
Right Hemiplegia	4	1	49	0	1	0	55
Spina Bifida	4	0	2	0	118	3	127
Spinal Injury	6	0	6	0	41	11	64
	217	63	127	12	310	54	783

Servo assisted braking

This was required by 183 (20%) of the group studied. Their sitting height and arm reach did not influence the decision, but their mean pressures were 24.929 lbs as against 66.374 lbs in the group not needing assistance. Ten people recorded less than 10 lbs pressure for braking. 28 clients (3%) needed radial servo controls due to particular muscle weakness; 16 of them had spinal injuries and 6 myopathies. The group needing braking assistance included:

	Number of people	% of the group
Arthritics	31	37
Spinal injuries	31	34
Myopathies	29	46
Congenital limb deformity	22	42
Cerebral palsy	18	16
Spina bifida and hydrocephalus	14	10
Multiple sclerosis	13	19
Poliomyelitis	10	36

Pedal Modifications

It is policy at Banstead to recommend that those using a left foot on the accelerator should have the pedal moved to the left of the brake for their use and easily returnable to the normal position for other drivers. In addition, enlarging the brake pad and/or raising the accelerator pedal to make it level with the brake, can help those who have some physical difficulty moving from one pedal to the other. Another possibility, especially when one foot operates the accelerator and the other the brake, is to locate the feet carefully on organ-style pedals with heel supports. Those with reduced stature may need the pedals superimposed above the original set to enable them to drive. These reasons together caused us to recommend 153 alterations to the pedals.

6. CONCLUSION

This study has helped to identify more clearly the types of disability, ages and other physical characteristics of disabled drivers in the U.K. Although this can only be regarded as the first phase of the project, patterns of car modification requirements are emerging, particularly in relation to some disability groups. The second phase will be to confirm these requirements when this group of people is on the road. The final phase will be to produce practical information booklets concerning the modification requirements for the major disability groups based on the information gained during these studies.

Notes:

(1) Anthropometrics: S.T. Pheasant: Department of Anatomy, Royal Free Hospital School of Medicine, London.

(2) For the purposes of car controls and seating requirements, the few clients who had spina bifida only with no history or evidence of hydrocephalus have been considered with those who had hydrocephalus.

(3) The Friedreich's ataxia, hydrocephalus and "Other" categories have been omitted from this table due to small numbers.

(4) The spinal injury clients attending Banstead for assessments are generally high level tetraplegics.

(5) Some clients were not recommended to drive because of visual impairments, perceptual difficulties and lack of physical control.

Acknowledgements:

I should like to acknowledge my gratitude for the anonymous donation which enabled computer time to be bought for the analysis of this data, and record my thanks to the Department of Transport and others who helped in the extraction and processing of the data.

Finally I would like to thank all my colleagues at Banstead Place Mobility Centre without whom this study would have been impossible.

THE CONTRIBUTION OF A DRIVING SIMULATOR IN THE DRIVING EVALUATION OF STROKE AND DISABLED ADOLESCENT CLIENTS

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The Contribution of a Driving Simulator in the Driving Evaluation of Stroke and Disabled Adolescent Clients

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Driving is an important privilege for individuals in our society. This privilege takes on monumental importance to a disabled invidividual who may be unable to use transportation independently in pursuit of vocation, leisure or personal freedom (Cutler, 1972; Dupuis, 1981; Hofkosh, Sipajlo & Brody, 1969; Negri and Ibison, 1979). Following a review of the literature, it is evident that training disabled drivers to provide their own transportation with a minimum of assistance will be more cost effective than developing expensive mass transit systems for the disabled (Dupuis, 1981; Negri and Ibison, 1979).

The driving program conducted in the Occupational Therapy Department at the Royal Ottawa Regional Rehabilitation Centre (RORRC), has been in existence for eleven years. A major tool used in the driving evaluation has been a Doron Driving Simulator. Occupational therapists have posed many questions about the usefulness of the simulator as an assessment and training tool. A study of the simulator is important to consumers investing in costly simulator equipment without justification of its value to their clients. It is also important to clinicians who need to know whether and how, the simulator can be used as an effective tool for assessing a patient's potential to learn or relearn driving activity. Therefore, the purpose of this study was to determine how the simulator contributes to the assessment and training of disabled adolescent and stroke clients.

Description of Driving Program

The driving program at the RORRC includes evaluation by an occupational therapist who evaluates physical and functional concerns as well as perceptual, cognitive and sensory functions. Following this, each client's physical ability to operate a motor vehicle is assessed on a Doron Driving Simulator. Responses to simulated driving situations are assessed and driving aids are introduced as necessary. If results from the occupational therapy assessment and sessions on the simulator indicate that the clients are suitable candidates for driving, appointments are scheduled for individual on road evaluations. Evaluations by physiatry, physiotherapy, psychology and speech therapy are included prior to the clients participating in an on road evaluation with the driving instructor. On the basis of these assessments, recommendations are made about the use of aids, the need for further instruction, or the appropriateness of the client's driving abilities. These are then forwarded to the Ministry of Transportation for follow-up.

Data Collection

Data were collected in two phases over a 21 month period for two different groups of disabled adolescent and stroke clients referred for driving evaluations. The two parts are called Phase I and Phase II. The data included simulator scores as well as subjective information in questionnaire form from the clients.

Description of Subjects

Six disabled adolescent and 11 stroke clients were involved in Phase I of the study. In Phase II there were 9 disabled adolescent and 30 stroke clients. These individuals presented with varying degrees of physical impairment and with mild cognitive and perceptual deficits. Clients with severe perceptual dysfunction are usually not referred for driving assessments as they are pre-screened by their physicians and members of the rehabilitation team. The adolescent clients were first time drivers whereas the stroke clients had many years of driving experience prior to their stroke.

RESULTS AND DISCUSSION

Driving Simulator Results

The difference between simulator results of the adolescent and stroke groups is demonstrated in Table 1.

Table 1

Driving Simulator Results

Phase I	Average Number Sessions	Average Total Time (hr)	Average Score Initial - Final	Average Increased	Overall Average
A	8	6.7	41% - 69%	28%	56%
S	5.5	4	30% - 37%	7%	32%
Phase II					
A	3.3	3.3	36% - 61%	25%	51%
S	3	2	35% - 36%	1%	34%

In Phase I, the adolescents higher initial score and dramatic ability to improve this score over time results in a higher overall average than for the stroke group. In Phase II, in spite of the fact that the average initial scores are similar for both groups, the adolescents tendency to improve their score again results in a higher average than for the stroke group. Not only do the differences in scores remain the same between phases, but for both groups the scores themselves remain similar even though the time spent on the simulator in Phase II was half of that of Phase I.

The adolescents ability to adapt to and learn to operate the simulator appeared to be responsible for their improved scores in Phase I. Thus in Phase II, once this tendency to improve scores was well established, further sessions on the simulator were considered no longer necessary. Since the stroke clients' score in Phase I did not improve significantly with time, once a consistent score was attained in Phase II further sessions on the simulator were no longer needed. For both groups the decreased amount of simulator time in Phase II did not influence simulator scores. One may then conclude that an average amount of time for useful simulator assessment of an adolescent client is about 3.3 hours and 2 hours for a stroke client.

Road Performance

To determine whether simulator scores were indicative of road performance, the average scores of clients who performed satisfactorily on the road were compared to the average scores of those clients that performed unsatisfactorily. A satisfactory on road result was an indication from the driving instructor of an adolescent client's potential to drive, or of a stroke client's demonstrated skill to safely operate a motor vehicle. An unsatisfactory on road result was either the therapist's judgement that the client was unsafe to proceed with the on road evaluation, or an indication from the driving instructor of an adolescent client's questionable potential to drive, or of a stroke client's present inability to safely operate a motor vehicle. Clients from both groups who did not pursue the learner's permit, which is required to complete the on road evaluation, were considered ineligible for on road assessment.

Adolescents with satisfactory on road outcomes had simulator scores averaging 50% or higher. Those with unsatisfactory on road outcomes may have improved their scores but plateaued early and averaged 35%. Furthermore those with satisfactory outcomes were either licenced to drive or were in driver training, while those with unsatisfactory results have been unable to drive. Therefore, it was proposed that simulator scores that improved and averaged at least 50% could be useful as a predictor of adolescent clients' driving success.

Table 2

Adolescent Road Performance

N=15	Number	Score	Follow-up
satisfactory	6	56%	3 licensed & driving 3 with permit & driving
unsatisfactory	2	35%	1 unsuitable for on road 1 suspended by M.O.T.

For the stroke client, an average simulator score of 35% was strong indication to the therapist that the client would perform satisfactorily on the road. Those with satisfactory on road results, who were contacted, maintained their driving privilege and were driving following the assessment. Clients in both phases who received unsatisfactory on road results had average simulator scores significantly lower than the predictor score of 35%.

Table 3

Stroke Road Performance - Satisfactory

	Number	Score	Follow-up
I N=11	7	36%	5 licensed & driving 2 unable to be contacted
II N=30	18	35%	16 licensed & driving 2 unable to be contacted

Table 4

Stroke Road Performance - Unsatisfactory

	Number	Score	Follow-up
I N=11	4	25%	2 unsuitable for on road 2 retested by M.O.T.: relicensed
II N=30	8	28%	3 unsuitable for on road 3 license suspended by M.O.T. 1 retested by M.O.T.: relicensed 1 unable to be contacted

The average simulator scores for adolescent and stroke clients who were ineligible for an on road assessment were consistent with the satisfactory on road performance group. At follow-up half of the stroke clients within this group were driving with Ministry approval. One might predict that the ineligible adolescents would perform satisfactorily on the road. Factors related to finances or family support may have influenced their lack of follow-up with the driving evaluation process.

Table 5

Ineligible for On Road Assessment

	Number	Score	Follow-up
A 1 & 11 N=15	7	55%	7 did not pursue learner's permit
S 11 N=11	0	-	-
S 11 N=30	4	40%	2 did not pursue learner's permit 1 retested by M.O.T.: driving 1 road test not necessary: driving

On road assessment confirmed that the simulator was useful in the assessment of all stated driving aids with two exceptions. A right sided directional indicator was required when using left hand controls on the stationary simulator because of its lack of momentum; it was not required on the road. Spinner knobs were often required on the simulator because of its rigid steering mechanism. Therefore, mechanical limitations of the simulator affected the ability to accurately assess the use of some aids. The module cannot simulate all vehicle types and features when assessing physical limitations and requirements of aids.

Clients' Responses to the Simulator

The results of the clients' responses to the simulator are illustrated in Figure 1. The majority in both groups indicated that the simulator improved their self-confidence. Despite their higher simulator scores, half the adolescent clients felt that the simulator was confusing to use. Perhaps it was the complexity of the unfamiliar driving task that was confusing as opposed to the simulator itself? Fewer stroke clients found the simulator confusing. The fact that their simulator scores were lower appears to reinforce that their previous habits interfered with performance, not confusion with the operation of the machine. Therefore, it is not surprising that the majority of stroke clients predicted that they would perform better on the road than on the simulator. With no previous driving experience with which to compare, only half of the adolescents predicted better road performance. The majority of clients in both groups indicated that time spent on the simulator was worthwhile.

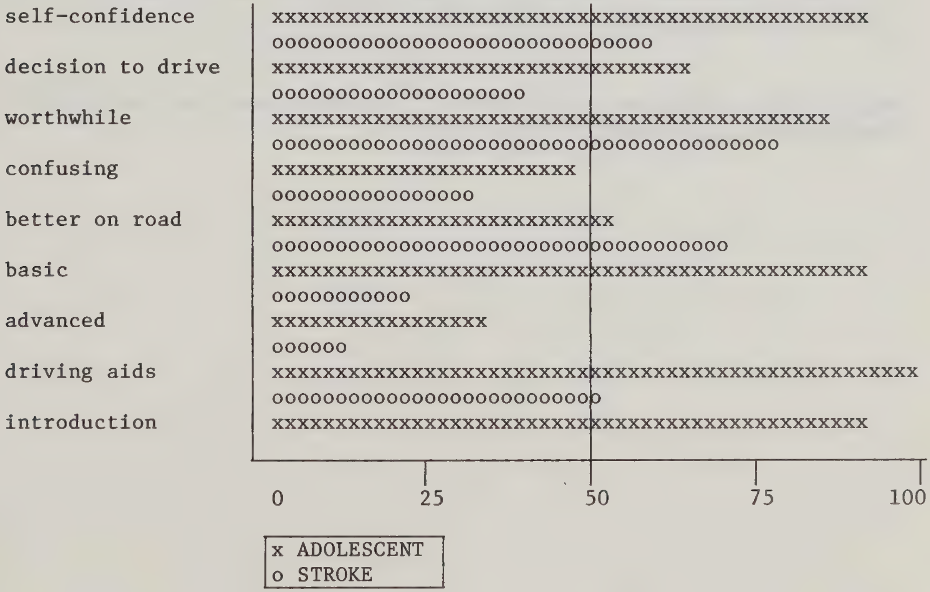

Figure 1

Clients' Response to the Simulator

CONCLUSION

In conclusion, the driving simulator was found to be a useful assessment and training tool for adolescent clients. Whereas, for the stroke client it served as an assessment tool with little training benefit. The average amount of time for simulator assessment of an adolescent client was 3.3 hours and 2 hours for a stroke client. There was strong evidence that satisfactory road performance could be predicted by simulator scores: a 50% score for the adolescent client and a 35% score for the stroke client. Both therapists and clients felt that the simulator was useful as an assessment and training tool for the use of driving aids. The majority of clients indicated that time spent on the simulator was worthwhile and that it served to increase their driving confidence.

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SPECIAL DRIVING NEEDS: DEFINITION, MARKET SIZE FOR CANADA AND THE UNITED STATES AND GUIDELINES FOR CONSUMER CHOICE

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INTRODUCTION

This paper is presented in two parts. Part one assesses the nature of driving- related disability and quantifies the number of driving-disabled persons in North America. The second part of the paper presents guidelines for the purchase of vehicles and adaptive driving aids by elderly and disabled persons.

PART ONE: SPECIAL DRIVING NEEDS ASSESSMENT

It appears paradoxical that despite the overwhelming consumer preference for private automobiles in North Amercia, the term "transportation- handicapped" has become synonymous with modes of **public** transportation. Indeed, every major survey in the field since 1973 attempts to define and measure the number of persons whose disabilities limit their use of conventional buses and trains. No surveys have been published regarding driving-related disability. Moreover, most major studies have focused on urban residents. Rural persons are far more dependent upon autos. This paper aims to bridge the gap. The work was initiated by the Transportation Development Centre as part of a larger effort to focus on the personal mobility problems of disabled persons.

Driving Disability Defined

A general definition of driving-disability might classify as driving-disabled any person who has a functional impairment that limits his ability to drive. However, such a definition fails to recognize that not everyone with such an impairment would be helped by even the most sophisticated adaptive equipment or specialized car or van. Illness or preference will prevent some from driving. Nor does it expose the likelihood that some persons who already drive without any obvious limitation might nevertheless benefit from minor adaptive equipment (such as convex mirrors to aid visibility among those with restricted neck motion) or enhanced "design awareness" -- that is, knowledge of ergonomic factors in auto design that an individual needs in order to make an informed choice when purchasing a vehicle.[1] In other words, the definition above is not useful as a basis for sizing the market for specialized vehicles, adaptive driving equipment (hand controls, special mirrors etc.), or information to enhance design-awareness.

1. For example, such factors would include the height of the door sill, a design feature that can impede entering and leaving the car for mildly arthritic persons, (see Part Two).

Model of the Driving-Disabled Population

A more useful definition in this respect emerges from the model developed in Figure 1. The model, which is largely self-explanatory, simply divides the total driving-aged population into those who drive now and those who do not; it then further sub-divides these two groups according to a range of functional criteria that establish their need and use for various kinds of driving aids and design-related information. Examination of the model reveals a useful system for classifying the driving disabled-population according to a priority of needs, as follows:

- Of highest priority are those whose health or disability prevents them from driving but for whom special equipment and design-awareness would make it possible to drive (probably in combination with driver-rehabilitation training);

- Second in priority are persons who already drive with the aid of special equipmment: although they do drive, they are ranked second because their need for special adaptive equipment is reflected by more serious physical disablement than experienced by those ranked third and fourth below;

- Third are persons who already drive without the aid of any adaptive driving aids, but who would nevertheless benefit from certain types of equipment; and

- Fourth in priority are those who already drive and have no need for any adaptive devices, but who would benefit from more design-awareness -- that is, from better ergonomic information upon which to select an auto that minimizes discomfort and other design-related driving problems.

Although refined versions of the typology presented here are possible, the model provides a useful basis for classifying the driving problems of disabled persons and for quantifying the number of persons with such problems.

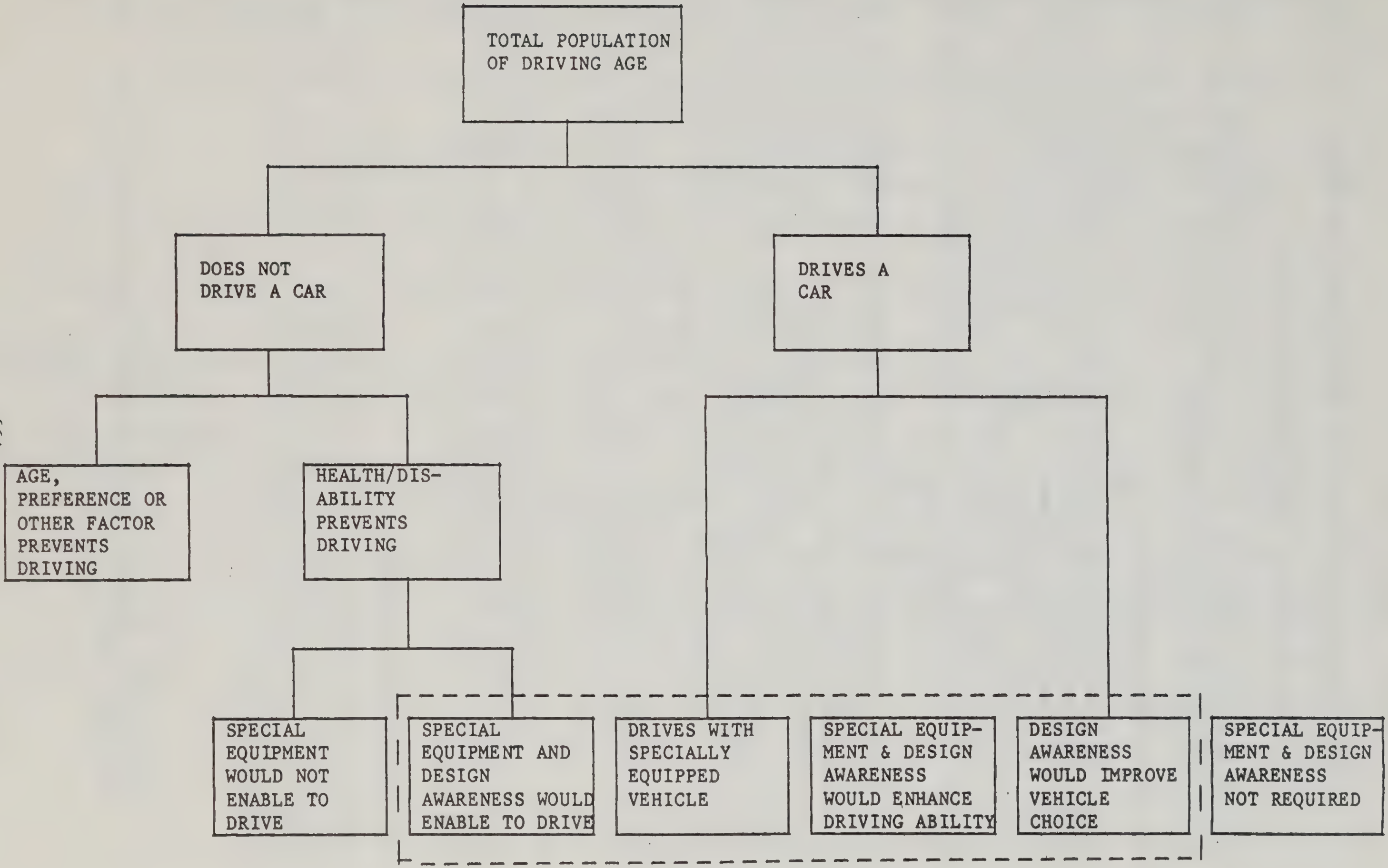
Data

The only source of information regarding driving-related disability is the U.S. Health Interview Survey. H.I.S. officials (of the Department of Health and Human Services) made computer tapes available to the authors for their analysis of this hitherto unexplored aspect of the survey results. As the data related only to the United States, statistical estimation techniques were used to devise demographic statistics for Canada. These are given in Appendix A.

The H.I.S. is conducted annually. However, specialized segments -- such as questions on transportation-related disabilities -- are asked less frequently and the last segment regarding transportation was conducted in 1977.

A two-phase methodology is used to produce the estimates. First, the results of three H.I.S. questions are cross-classified with various disability-related data. The sample numbers have been expanded to the total population using the probability expansion techniques of the H.I.S. The three questions are:

FIGURE 1. DEFINING THE DRIVING-HANDICAPPED POPULATION



- o Do you drive a car?
- o Does health or disability prevent you from driving a car? and
- o Is the car you drive specially equipped?

Numbers of persons answering "yes" or "no" are then classified in a series of cross-tabulations according to the degree of limitation caused by their disability and the kind of special aid(s) they use (if any).

The Driving-Aged Population

Since the legal driving age varies from state to state in the U.S. (and from Province to Province in Canada), the driving-aged population is defined here as persons aged 20 years or more. It was decided not to bound the upper age limit since the proportion of elderly persons who drive is growing steadily.[2] Moreover, the very problem at hand is that of elderly persons (among others) whose disability -- not age alone -- prevents them from driving. Of course, age will, in effect, prevent some from driving and this factor is touched on again below.

Table 1 also classifies the driving-aged population according to the degree of activity limitation caused by their disability or health problem. The analysis groups persons into three categories of activity limitation brought on by disability or health. The first category -- "unable to carry on a major activity" -- refers to working, keeping house, and going to school. The second category -- "limited in amount or kind of majority activity" -- refers to the same three categories. The third category -- "limited but not in major activity" -- refers to any activity other than working, keeping house, or going to school in which the survey respondent felt limited because of disability or health problems. The three groups are thus presented in declining order of severity with regard to the functional impact of a person's health problems or disability. Note also that "disability" can have any cause: including age or other non-specific and non-medical factors.

Table 1 reveals that the incidence of debilitating condition among non-drivers is twice as high as it is among the driving population. As the table shows, 9.2 million persons out of the 23.6 million non-drivers (39 percent) report some limitation in activity while only 14 percent of drivers report a limitation.

The Non-Driving Population

Among the 23.6 million non-drivers an estimated 17.5 percent (4.12 million persons) cite a disability or health problem as a barrier to driving. This leaves an estimated 19.5 million non-drivers for whom age, preference, or other factors, other than health or disability, are the likely reason for their not driving.

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2. David Lewis, Economic of Specialized Transportation, London School of Economics, 1985.

TABLE 1: ESTIMATED POPULATION AGED 20 YEARS OR MORE BY DEGREE OF ACTIVITY LIMITATION AND DRIVING CATEGORY (in thousands of persons)

Debility	Total		Drives a Car		Does Not Drive Car	
	Thousands of of Persons	Percent	Thousands of Persons	Percent	Thousands of Persons	Percent
Unable to Carry on Major Activity	7,509.3	5.4	3,956.1	3.5	3,419.1	14.5
With Limitation in Amount or Kind of Major Activity	13,133.1	9.4	8,298.5	7.3	4,566.0	19.3
With Limitation But Not In Major Activity	113,996.7	81.4	97,270.7	85.7	14,349.9	60.8
Total	139,964.7	100.0	113,501.0	100.0	23,607.0	100.0

Predictably, the incidence of functional disability is extremely high among those whose health or disability prevents them from driving. As shown in Table 2, nearly half the group report that they are unable to carry on any form of major activity and another 31 percent are limited in the amount or kind of major activities they can perform.

The model developed in Figure 1 indicates that not all persons whose health or disability prevents them from driving necessarily could do so even with special vehicles or equipment. Although the H.I.S. does not attempt to make such a distinction, "high" or "low" estimates are possible. At the high end, it could be assumed that, in the long-run, nearly all 4.2 million persons who cite health or disability as a reason for not driving could do so once medical and technological advances enable even the most severely disabled person to use a suitably equipped vehicle. For the near-term, of course, such an assumption is obviously unrealistic. Thus a "low" case might assume that most of those who cite an inability to take part in any major activity today (1.98 million persons -- see Table 2) could not be expected to drive. This would reduce the actual "market" to an estimated 2.14 million persons (4.12 million persons minus 1.98 million persons). This might still prove too high an estimate since all age groups are included. Many people in their 80's drive today however, and any further refinement would thus be entirely arbitrary.

The Driving Population

The model (see Figure 1) includes three groups of drivers among the driving-handicapped population -- those who drive now with specialized vehicles or adaptive equipment; those for whom some special equipment would enhance driving comfort, safety, and efficiency; and those for whom design-awareness alone would lead to a better choice of car.

According to the statistics in Table 3, an estimated 197,000 persons in the United States drive today with the aid of adaptive equipment such as hand controls or a specialized van. In Canada it is estimated that 15,000 persons drive with the aid of adaptive equipment (see Table A-3 of the Appendix).

Although the great majority of drivers do not use any adaptive equipment, rehabilitation literature suggests that many disabled drivers would benefit from some form of adaptive device or from a car that is easier for them to use. Although the H.I.S. makes no attempt to identify that group directly, the data in Table 3, make some broad estimates possible. As the table shows, an estimated 14.1 percent of total drivers (15.8 million persons) who use no special equipment report a health condition or disability that prevents or limits their participation in some form of major activity (this estimate is the sum of rows 1, 2 and 3 in column 5 of Table 3). Since such limitation is strongly associated with a severe to moderate disability, it could be assumed that such persons would benefit from some form of adaptive device and/or from enhanced design-awareness. The division of persons among these two groups can only be roughly estimated. One approach would assume that drivers who are unable to carry on a major activity would benefit from adaptive equipment (3.82 million persons -- Table 3), while those with less severe disabilities (12 million persons) would require enhanced design-awareness only.

TABLE 2: ESTIMATED NON-DRIVING POPULATION AGED 20 YEARS OR MORE BY DEGREE OF ACTIVITY LIMITATION AND REASON FOR NOT DRIVING (in thousands of persons)

Debility	Does Not Drive Car (Thousands of persons)	Disability or Health Problems Prevents from Driving: Thousands of Persons	Percent of Row Total	Percent of Column Total
Unable to Carry on Major Activity	3,419.1	1,908.0	57.9	48.0
With Limitation in Amount or Kind of Major Activity	4,566.0	1,267.5	27.8	30.7
With Limitation But Not In Major Activity	1,272.0	312.6	24.6	7.6
Not Limited in Activities	14,349.9	563.5	3.9	13.6
Total	23,607.0	4,051.6	17.5	100.0

SOURCE: Adapted from U.S. Health Interview Survey, 1977.

TABLE 3: ESTIMATED POPULATION AGED 20 YEARS OR MORE BY DEGREE OF ACTIVITY LIMITATION AND DRIVING CATEGORY LIMITATION AND CATEGORY OF VEHICLE (in thousands of persons)

Debility	Drives Car (Thousands of Persons)	Car Specially Equipped			Car Not Specially Equipped		
		Thousands of Persons	Percent of Row Total	Percent of Column Total	Thousands of Persons	Percent of Row Total	Percent of Column Total
Unable to Carry on Major Activity	3,956.1	49.6	1.3	25.2	3,817.9	96.5	3.4
With Limitation in Amount or Kind of Major Activity	8,298.5	53.1	0.6	27.0	8,126.5	97.9	7.2
With Limitation But Not In Major Activity	3,975.7	22.2	0.6	11.3	3,901.4	98.7	3.5
Not Limited in Activities	97,270.7	72.0	0.1	36.6	96,321.5	99.0	85.9
Total	113,501.0	196.9	0.2	100.0	112,167.3	98.9	100.0

SOURCE: Adapted from U.S. Health Interview Survey of 1977

NOTE: Rows do not add because some survey responses (about 2 pecent) were classified "unknown."

The Driving Disabled Population: A Priority of Needs

Based on the foregoing analysis, it is possible to summarize the estimated driving-disabled population according to the four-level priority scheme of driving-related disabilities identified under the model earlier, as follows:

Priority Group	Number of Persons			
	U.S.	Canada	U.S.	Canada
1. Health or Disability Prevents Driving But Special Equipment And Design Awareness Would Enable To Drive	2,140,000	225,000	11.8	11.5
2. Drive Now With Special Equipment	197,000	15,000	1.1	0.8
3. Drive Now Without Special Equipment But Would Benefit From Such Equipment	3,820,000	410,000	21.0	21.0
4. Drive Now Without Special Equipment But Would Benefit From Enhanced Design Awareness	12,000,000	1,300,000	66.1	66.7
Total Driving Handicapped	18,157,000	1,950,000	100.0	100.0

As seen above, a total of some 18 million persons in the United States (1.9 million in Canada) are identified as driving-handicapped. The majority -- about 67 percent -- do not require any adaptive equipment, however. Rather, these are individuals who might benefit from enhanced design-awareness in choosing a vehicle.

Personal Mobility Aids Used by Driving-Handicapped Persons

A major factor in the choice of a car and adaptive driving equipment is the type of mobility aid an individual uses. Use of a wheelchair, for example, draws vehicle design factors into consideration that would be less critical to a person with an artificial arm. On the other hand, the individual with an artificial arm would need to consider hand controls that might be unnecessary for a wheelchair user. This section estimates the number of driving-disabled persons who use mobility aids and classifies persons according to the type of aid they use.

According to the statistics presented in Table 4 an estimated 5.6 million persons in the United States -- just under four percent of the total U.S. driving-aged population -- use some form of mobility aid. Most (about 48 percent) use a cane while about 578,000 persons use a wheelchair. Use of an aid is far more prevalent among non-drivers than it is among those who drive a car. Among drivers, only 2.5 percent use some form of special aid whereas almost 12 percent of non-drivers use some form of mechanical equipment to aid mobility.

The need for relatively more critical mobility aids is greater among non-drivers as well. This is apparent in Table 4, which indicates that 16 percent of non-drivers use a wheelchair versus only 4.2 percent among drivers.

Finally, the statistics in Table 5 indicates that use of a wheelchair or leg brace (which might accompany wheelchair usage) are more likely than other aids to be associated with an inability to drive because of health or disability. As the table shows, almost 80 percent of non-drivers who use a wheelchair or a leg-brace cite that their disability or health problems prevent them from driving. Note that considerable overlap among these two groups exist in Tables 4 and 5; that is, many persons with an artificial leg are also wheelchair users. This suggests wheelchair users probably represent the top priority group in the allocation of any government subsidies for auto purchase.

TABLE 4. ESTIMATED POPULATION AGED 20 YEARS OR MORE BY AID USED AND DRIVING CATEGORY (in thousands of persons)

Aid Used	Total		Drives Car		Does Not Drive a Car	
	Thousands of Persons	Percent	Thousands of Persons	Percent[a]	Thousands of Persons	Percent
Artificial Arm	59.6	1.1	43.4	1.6	16.2	0.6
Artificial Leg	189.7	3.4	125.9	4.7	61.9	2.2
Brace Leg/Foot	303.7	5.4	189.8	7.0	110.4	3.9
Brace Other	698.7	12.5	548.0	20.3	145.0	5.1
Brace NOS[b]	214.2	3.8	154.2	5.7	59.9	2.1
Crutches	538.2	9.7	359.0	13.3	170.0	6.0
Cane	2,703.8	48.5	930.5	34.5	1,746.1	61.7
Special Shoes	878.8	15.8	616.	22.9	260.6	9.2
Wheelchair	578.1	10.4	112.1	4.2	457.0	16.2
Walker	649.1	11.6	100.2	3.7	533.8	18.9
Other	160.8	2.9	90.0	3.3	67.0	2.4
Total[c]	5,581.9	---	2,697.2	---	2,828.5	---

SOURCE: U.S. Health Interview Survey, 1977

a. Columns do not add to 100 percent because individuals can be included in more than one group. Rows do not add because some survey (2 percent) responses here classified "unknown".

b. NOS = Not Elsewhere Specified

c. Total shown is number of individuals. Thus, individuals appearing in more than one category are counted once.

TABLE 5. ESTIMATED NON-DRIVING POPULATION AGED 20 YEARS OR MORE BY AID USED AND REASON FOR NOT DRIVING (in thousands of persons)

Aid Used	Does Not Drive Car (In thousands of Persons)	Disability of Health Prevents from Driving		
		Thousands of Persons	Percent of Row Total	Percent of Column Total
Artificial Arm	16.2	7.3	45.1	0.5
Artificial Leg	61.9	43.8	70.8	3.0
Brace Leg/Foot	110.4	88.0	79.7	6.0
Brace Other	145.0	61.9	42.6	4.3
Brace NOS	59.9	27.6	46.1	1.9
Crutches	170.0	104.5	61.5	7.2
Cane	1,746.1	117.6	49.7	59.6
Special Shoes	260.6	7.6	45.2	8.1
Wheelchair	457.0	356.6	78.0	24.5
Walker	533.8	321.5	60.2	22.1
Other	67.0	36.9	55.0	2.5
Total	2,828.5	1,458.4	51.5	---

SOURCE: U.S. Health Interview Survey, 1977

NOTES: NOS = Not Elsewhere Specified. Columns do not add because individuals can be included in more than one group. Rows do not add because some survey responses (about 2 percent) were classified "unknown".

PART TWO: VEHICLE AND ADAPTIVE AIDS FOR ELDERLY AND DISABLED DRIVERS - A BUYERS GUIDE

To be sure, a properly chosen vehicle can add a whole new dimension to the life of someone whose mobility is restricted by a disability. An improperly chosen vehicle, on the other hand, can cause as many problems as it solves. For example, a car may not provide a wheelchair user with enough space between the front and back seats to load a wheelchair. Or, options or controls that would allow someone with a missing or weak limb to more easily manoeuvre a vehicle might not have been installed. In these and other instances, the vehicle could soon begin to seem more of a burden than an asset.

A Consumer Guide

To help guide elderly and disabled persons in the choice of a vehicle or adaptive vehicle equipment, a buyer's guide has been prepared by James F. Hickling Management Consultants Limited and published by the Transportation Development Centre.[1] The guide is designed to help elderly and disabled persons choose a vehicle and related equipment that correspond to their distinctive needs. All categories of driving-related disability identified in Part One above are addressed in the guide.

The guide does not tell the user which vehicle to buy or how to equip it. Every disabled person has different needs. The particular mix of physical strengths and weaknesses, skills and impairments, sets one apart from other individuals. Except in certain circumstances, no one can say exactly which car to buy and with which options and adaptive equipment. Only the individual involved can ultimately make that decision.

The guide is organized as a logical series of steps that can help an individual make his personal selection, (Figure 2).

Step 1 is designed to help the user match his disability to the kind of driving aids most likely to be needed. Figure 3 lists the disabilities, addressed in this guide. Figure 4 provides more detailed information on selected disabilities from the list provided in Figure 3. Some of these driving aids come as either standard or optional equipment with most cars, trucks or vans. Others are adaptive equipment specially designed for specific disabilities.

If the user decides that he needs special adaptive equipment, he can refer to **Step 2**, which lists and describes the various types of special adaptive equipment available, their manufacturers, and the distributors in each geographic area.

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1. The Guide may be obtained by contacting L. Suen of the Transportation Development Centre, Montreal, Canada. (514)238-0002.

FIGURE 2: THE 5-STEP GUIDE TO BETTER DRIVING

STEP 1 DISABILITIES THEIR EFFECTS ON DRIVING AND SUGGESTED ADAPTIVE DRIVING AIDS	Matching adaptive equipment to specific disabilities and driving needs
STEP 2 INVENTORY OF ADAPTIVE DRIVING AIDS	Adaptive equipment: what is available and where you can find it
STEP 3 VEHICLE DESIGN CONSIDERATIONS	Things to consider when buying a vehicle
STEP 4 VEHICLE COMPARISON CHARTS	Ratings of 170 cars, vans and light trucks
STEP 5 COMPARISON CHECKLIST FOR VEHICLE BUYERS	A checklist to help you evaluate and compare models

FIGURE 3: LIST OF DISABILITIES ADDRESSED IN GUIDE

1. left leg missing or non-functional
2. right leg missing or non-functional
3. both legs missing or non-functional
4. short legs
5. left arm below elbow missing or non-functional
6. right arm below elbow missing or non-functional
7. both arms below elbow missing or non-functional
8. left arm above elbow missing or non-functional
9. right arm above elbow missing or non-functional
10. both arms above elbow missing or non-functional
11. short arms
12. lack of manual dexterity
13. both arms and both legs disabled (quadriplegia)
14. lack of range of motion - arms
15. lack of range of motion - shoulders
16. lack of range of motion - neck
17. lack of range of motion - hips
18. small body size
19. lack of body balance
20. general muscle weakness
21. poor muscle control
22. poor endurance, fatigue
23. poor vision
24. aging

FIGURE 4: THE EFFECTS ON DRIVING AND SUGGESTED DRIVING AIDS FOR SELECTED DISABILITIES

1. LEFT LEG MISSING OR NON-FUNCTIONAL

Effects on Driving:

1. Inability to use left foot on dimmer switch and parking brake.
2. Possible inability to maintain body balance (depending on extent of amputation).
3. Inability to use clutch.
4. Possible interference of leg or foot with driving mechanisms.

Suggested Driving Aids:

1. Hand-operated dimmer switch and parking brake (or centre-console parking brake).
2. Shoulder or chest safety belts; arm rests.
3. Automatic transmission.
4. A restraint (e.g. belt, loop, or barrier of some type) to keep the disabled leg or foot from lodging against the brake or accelerator.

2. LEFT ARM BELOW ELBOW MISSING OR NON-FUNCTIONAL

Effects on Driving:

1. Difficulty performing hand-over-hand steering manoeuvres.
2. Inability to shift gears while steering.
3. Difficulty grasping and pulling left-hand dash controls.

Suggested Driving Aids:

1. Power steering and spinner knob attached to the steering wheel, mounted at the 3 or 4 o'clock position, for the sound hand.
2. Automatic Transmission.
3. Rings attached to left-hand dash controls.

3. LACK OF MANUAL DEXTERITY

Effects on Driving:

1. Limited ability to grasp and turn steering wheel.
2. Limited ability to grasp and operate ignition key and dashboard controls.
3. Difficulty releasing hand-operated parking brake.

Suggested Driving Aids:

1. Tri-post, "V", or cuff-type steering wheel spinner.
2. a. Ignition key holder.
   b. Rings or other adaptations on dashboard controls.
3. Foot-operated parking brake, or extension loop on the parking brake handle.

4. SMALL BODY SIZE

Effects on Driving:

1. Insufficient height to see out windows.
2. Inability to reach brake, accelerator, dimmer switch, and parking brake.

If arms are short:

3. Inability to reach dashboard controls and ignition key.
4. Difficulty performing many hand-over-hand steering manoeuvres.

Suggested Driving Aids:

1. Specially constructed seat to raise the driver
2. Extensions on brake, accelerator, dimmer switch, and parking brake or hand-operated controls.
3. Extensions for dashboard controls and ignition.
4. Steering spinner knob.

Step 3 begins with the key points a disabled person should consider when shopping for a vehicle. The user should read this section in order to best make use of the vehicle rating charts that follow.

A vehicle rating survey was conducted for 170 cars, trucks and vans. The rating charts, included in **Step 4**, can help the user to narrow the range of possible choices to a few vehicles. He can then proceed to test-drive the most promising cars, trucks or vans, to find the model that best corresponds to his distinctive needs.

Step 5 consists of a detachable comparison checklist that can be used when actually shopping for a vehicle.

Of course, a purchasing decision will be made not only from the standpoint of a disability, but on the basis of all of the considerations involved in choosing a car (price, appearance, performance, fuel economy, safety, etc.). Once again, the final choice in any of these matters must be yours: The **user** is in the driver's seat.

The final section provides a guide to disabled drivers' education courses and financial assistance programs available in each Canadian province and territory.

Where and How to Purchase the Buyers Guide

"Vehicles and Adaptive Aids for Elderly and Disabled Drivers - A Buyers Guide" is available in Canada though authorized bookstore agents and other bookstores or by mail from

> Canadian Government Publishing Centre
> Supply and Services Canada
> Ottawa, Ontario
> K1A 0S9

The price in Canada is $7.25 and $8.70 in other countries.

TABLE A-1: ESTIMATED CANADIAN NON-DRIVING POPULATION AGED 20 YEARS OR MORE BY AID USED AND REASON FOR NOT DRIVING (IN THOUSANDS OF PERSONS)

AID USED	DOES NOT DRIVE CAR	DISABILITY OF HEALTH PROBLEMS PREVENTS FROM DRIVING		
	THOUSANDS OF PERSONS	THOUSANDS OF PERSONS	PERCENT OF ROW TOTAL	PERCENT OF COLUMN TOTAL
Artificial arm	1.7	0.8	45.1	0.5
Artificial leg	6.4	4.5	70.8	3.0
Brace leg/foot	11.5	9.1	79.7	6.0
Brace other	15.0	6.4	42.6	4.3
Brace NOS	6.2	2.9	46.1	1.9
Crutches	17.6	10.8	61.5	7.2
Cane	181.2	90.0	49.7	59.6
Special shoes	27.0	12.2	45.2	8.1
Wheel chair	47.4	37.0	78.0	24.5
Walker	55.4	33.4	60.2	22.1
Other	7.0	3.8	55.0	2.5
TOTAL	293.1	151.0	51.5	100.0

Source: U.S. Health Interview Survey, 1977

Notes: NOS - Not Elsewhere Specified

Columns do not add because individuals can be included in more than one group. Rows do not add because some survey respondents replied "don't know".

TABLE A-2: ESTIMATED CANADIAN POPULATION AGED 20 YEARS OR MORE BY AID USED AND DRIVING CATEGORY (IN THOUSANDS OF PERSONS)

AID USED	TOTAL		DRIVES CAR		DOES NOT DRIVE CAR	
	THOUSANDS OF PERSONS	PERCENT	THOUSANDS OF PERSONS	PERCENT	THOUSANDS OF PERSONS	PERCENT
Artificial arm	6.2	1.1	4.5	1.6	1.7	0.6
Artificial leg	19.7	3.4	13.1	4.7	6.4	2.2
Brace leg/foot	31.5	5.4	19.7	7.0	11.5	3.9
Brace other	72.5	12.5	56.9	20.3	15.0	5.1
Brace nos	22.2	3.8	16.0	5.7	6.2	2.1
Crutches	55.8	9.7	37.3	13.3	17.2	6.0
Cane	280.5	48.5	96.5	34.5	181.2	61.8
Special shoes	91.2	15.8	64.0	22.9	27.9	9.2
Wheelchair	60.0	10.4	11.6	4.2	47.4	16.2
Walker	67.3	11.6	10.4	3.7	55.4	18.9
Other	16.7	2.9	9.3	3.3	7.0	2.4
TOTAL	578.6	100.0	279.7	100.0	293.1	100.0

Source: U.S. Health Interview Survey, 1977.
Notes: NOS = Not Elsewhere Specified
Columns do not add because individuals can be included in more than one group. Rows do not add because some survey respondents replied "don't know".

TABLE A-3: ESTIMATED CANADIAN DRIVING POPULATION AGED 20 YEARS OR MORE BY DEGREE OF ACTIVITY LIMITATION AND CATEGORY OF VEHICLE (IN THOUSANDS OF PERSONS)

DEBILITY	DRIVES CAR	CAR SPECIALLY EQUIPPED			CAR NOT SPECIALLY EQUIPPED		
	THOUSANDS OF PERSONS	THOUSANDS OF PERSONS	PERCENT OF ROW TOTAL	PERCENT OF COL. TOTAL	THOUSANDS OF PERSONS	PERCENT OF ROW TOTAL	PERCENT OF COL. TOTAL
Unable to carry on major activity	415	5.0	1.2	33	410	98.8	3.4
With limitation in amount or kind of major activity	871	4.0	0.5	27	867	99.5	7.3
With limitation but not in major activity	417	2.0	0.5	13	415	99.5	3.5
Not limited in activities	10,213	4.0	0.04	27	10,209	99.9	85.8
TOTAL PERSONS	11,916	15.0	0.10	100	11,901	99.9	100.0

Source: Adapted from U.S. Health Interview Survey of 1977

Note: Rows do not add because some survey respondents replied "don't know"

TABLE A-4: PRIORITY OF NEEDS-CANADA

Priority Group	Number of Persons	Percent
Health or Disability Prevents Driving but Special Equipment and Design-Awareness Would Enable to Drive	225,000	11.5
Drive Now with Special Equipment	15,000	0.8
Drive Now Without Special Equipment but Would Benefit from Such Equipment	410,000	21.0
Drive Now Without Special Equipment But Would Benefit from Enhanced Design Awareness	1,300,000	66.7
Total Driving-Handicapped	1,950,000	100

TABLE A-5: ESTIMATED CANADIAN NON-DRIVING POPULATION AGED 20 YEARS OR MORE BY DEGREE OF ACTIVITY LIMITATION AND REASON FOR NOT DRIVING (IN THOUSANDS OF PERSONS)

DEBILITY	DOES NOT DRIVE CAR	DISABILITY OF HEALTH PROBLEMS PREVENTS FROM DRIVING		
	THOUSANDS OF PERSONS	THOUSANDS OF PERSONS	PERCENT OF ROW TOTAL	PERCENT OF COL. TOTAL
Unable to carry on major activity	359	208	57.9	48.0
With limitation in amount or kind of major activity	479	133	27.8	30.7
With limitation but not in major activity	134	33	24.5	7.6
Not limited in activities	1,507	59	3.9	13.6
TOTAL	2,479	433	17.5	100.0

Source: Adapted from U.S. Health Interview Survey, 1977

TABLE A-6: ESTIMATED CANADIAN POPULATION AGED 20 YEARS OR MORE BY DEGREE OF ACTIVITY LIMITATION AND DRIVING CATEGORY (IN THOUSANDS OF PERSONS)

DEBILITY	TOTAL		DRIVES CAR		DOES NOT DRIVE CAR	
	THOUSANDS OF PERSONS	PERCENT	THOUSANDS OF PERSONS	PERCENT	THOUSANDS OF PERSONS	PERCENT
Unable to carry on major activity	788	5.4	415	3.5	359	14.5
With limitation in amount or kind of major activity	1,379	9.4	871	7.3	479	19.3
With limitation but not in major activity	559	3.8	417	3.5	134	5.4
Not limited in activities	11,969	81.4	10,213	85.7	1,507	60.8
TOTAL PERSONS	14,695	100.0	11,916	100.0	2,479	100.0

Source: Adapted from U.S. Health Interview Survey of 1977

Note: Rows do not add because some survey respondents replied "don't know."

AN ADVISORY CENTRE
FOR DISABLED CAR-USERS

by
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AN ADVISORY CENTRE FOR DISABLED CAR-USERS

by M.J. Heraty, C.G.B. Mitchell and P.R. Oxley

1. INTRODUCTION

Ownership or use of a private car is a major contributory factor in the mobility and social integration of disabled people. In many cases a car is essential for them to find and keep employment, to look after themselves and their families, and to have the freedom to participate in activities which are enjoyed by other people who are not disabled.

It has been estimated[1] that there are about 500,000 drivers in Britain with some form of disability and some 50-100,000 cars converted for the use of disabled drivers. A small proportion of disabled car users can be helped through the Government's Mobility Allowance, a tax-free cash benefit which may be used, inter alia, for the purchase and operation of vehicles. The Allowance is, however, restricted in its application to people "unable or virtually unable to walk" and is only granted to a minority (perhaps about a tenth) of all people with mobility handicaps[2]. In 1986 about 420,000 people receive Mobility Allowance, many of whom do not drive.

Whether helped by the Mobility Allowance or not, disabled people have various problems in learning how to drive and choosing a suitable car:

(a) Because many disabled people need to have their cars specially modified before they can begin to learn to drive, and driving schools do not commonly have suitably converted cars available, potential drivers often have to expend money on purchasing vehicles before they know whether or not they will be able to master the driving task.

(b) Disabled people who are already drivers often have to buy cars without being able to check them for suitability; few dealers carry stocks of converted cars so that disabled potential purchasers may make test drives.

As a contribution to the solution of these problems, MAVIS, the Mobility Advice and Vehicle Information Service, was opened in December 1985. This paper discussed the planning process that led towards the MAVIS's establishment and gives some details of its early operations.

2. EXISTING PROVISIONS FOR ADVICE AND ASSESSMENT

Some schemes have already been developed in Britain to help to meet the demand for assessment of a disabled person's likely capability to drive and for the provision of advice on types of car and adaptations most suitable for the individual disabled driver.

One nationwide commercial driving school has a section with converted cars, which is devoted to advising disabled people on whether it would be worth their trying to learn to drive and what types of adaptations would be most appropriate. However, some disabled people question whether commercial

pressures may lead to its recommendations being optimistic, and this scheme is regarded with suspicion by some of the people who most need it. Objectively, the school appears to offer a dedicated and professional service, despite limited facilities.

Some motor manufacturers have roving demonstrator vehicles on which disabled people who are potential purchasers may make test drives, but the commercial pressures are obvious.

A few hospitals, including the Astley Ainslie Hospital in Edinburgh, the Derwent Hospital in Derby and the special spinal injuries centre at Stoke Mandeville, have specialised centres on the premises which offer driving assessment and advice, and sometimes instruction, often as part of a total package of rehabilitation services. These centres offer good professional advice but use medical staff to carry out a range of tests, including psychological tests, which non-disabled drivers do not have during their training period. For that reason some disabled people object to using the hospital-based services.

All other schemes to assess and advise potential or actual disabled drivers are run by charities, voluntary bodies, National Health Service, or other non-profitmaking organisations, the major one being the Queen Elizabeth's Foundation Mobility Centre at Banstead.

It is apparent that each of the existing facilities has its own strengths but most have some deficiencies. In particular, there has been criticism by the disabled community of the amount of medical and psychological testing which is included in some assessment procedures. The resources in terms of both staff and facilities are somewhat limited at all centres and this position is likely to worsen as car ownership rises among disabled people. Nevertheless these centres, like the commercial and hospital-linked schemes, do a good job and are demonstrating the need for such services.

The lack of a permanent well-equipped central focus for all types of enquiry and practical testing was partially demonstrated by the response to the Mobility Roadshows organised by the UK Department of Transport (DTp) in 1983 and 1985. This exhibition of adapted cars, conversion devices, wheelchairs and associated equipment was held at the Transport and Road Research Laboratory (TRRL - the DTp's research establishment at Crowthorne in Berkshire), which also enabled disabled drivers to test drive adapted vehicles on the TRRL's off-road track. The 1985 Roadshow was attended by 12,000 visitors (who took around 1,500 test drives) in three days.

3. RELEVANT EXPERIENCE FROM OVERSEAS

Officers of the TRRL visited Denmark, Sweden and Norway in 1983 to investigate the provisions made in those countries for the assessment of disabled drivers and the adaptation of cars[3]. In all three countries there are well-equipped institutes to advise on, and develop, vehicle adaptations, supported by central government funding provisions to individual drivers, the institutes themselves, driving instructors, and so on. There appeared to be general agreement on the value of a pragmatic approach to the assessment of disabled drivers backed up by specialised sight tests, especially where brain damage had caused limitations to the field of vision.

In parallel, a group of DTp officers, leading representatives of disabled drivers organisations and the head of the Banstead Centre visited Belgium to inspect facilities there; subsequently they began moves to initiate similar facilities in the United Kingdom.

Following these relatively brief visits by the DTp's own staff, the Department commissioned a study tour by members of the Motor Industry Research Association (MIRA) in 1984[4]; they visited Denmark, Norway, Sweden, France, Belgium, the Netherlands, Germany and Switzerland, concentrating particularly on car control conversions for disabled drivers and considering the ways in which these are promulgated among the potential users.

Varying provisions are made in each country but the conclusion was drawn that Britain was falling behind other countries in northern Europe in the provision which was made through official channels, for the assessment and advising of disabled people wishing to learn to drive, and of disabled drivers wishing to purchase a new vehicle. This was particularly inappropriate as Britain appears to be unique in Europe with its Mobility Allowance scheme: even where cash payments are made to disabled people to assist them with their mobility, little advice was available on how to spend the funds most effectively.

4. OPTIONS FOR THE DEVELOPMENT OF FACILITIES

The TRRL identified the options available to rectify the situation and, towards the end of 1984 commissioned consultants to evaluate them. The findings of the feasibility study exercise, completed in the spring of 1985, were as follows in relation to each option:

(a) Fund the Banstead centre to expand

The disadvantages were assessed as the limitations of the space available at Banstead and the medically-oriented nature of their assessment procedures.

(b) Using the resources of charitable organisations

There appears to be a scarcity of either the technical and/or the management expertise to run centres on a large scale, in each of the existing charitable organisations who are involved in the provision of theoretical or practical advice. This option was felt to be "high risk".

(c) Using the resources of commercial organisations

It was felt that commercial bias (or clients' perception of it) would be an unacceptable by-product of this option if individual motor manufacturers or driving schools were supported in this way.

(d) Basing advisory centres at Artificial Limb and Appliance Centres (ALAC's)

ALAC's (run by the Department of Health and Social Security) have technical expertise in the field, through their experience of supplying "invalid tricycles" and they also obviously have medical expertise.

However few, if any, have the necessary off-road space and their number would militate against all ALAC's being equipped with a wide range of adapted cars, etc. Furthermore, following the recent McColl Report, their future is somewhat uncertain.

(e) Establishing a centre at TRRL, Crowthorne

This option, which was finally selected, presented the advantage of the TRRL's unique facilities in terms of off-road space for test drives, available accommodation and experienced technical staff and support services. For a brand new centre, the opportunity could be taken to learn from the experience of others, in order to establish from the beginning what were believed to be the most appropriate set of procedures and operating practices. Such a centre would be clearly viewed as independent of commercial pressures, although it would have to distance itself from the formal licensing and testing functions of DTp and its Driver and Vehicle Licensing Centre - DVLC. It would be unlikely to be able to offer specialised assessments of medically-complex cases, because of lack of medically-trained staff. The location, although central in terms of population, is not ideal in terms of accessibility.

(f) Establishing a network of DTp centres

This is seen as a development of option (e), with the TRRL centre as the first. It would be costly to try to establish a network all at once; a gradual build-up of numbers would allow the scale of demand to be assessed, enable practical lessons learned from establishing one centre to be applied to others, and readily permit on-the-job staff training.

5. THE PREFERRED OPTION

The case for having the first centre at the TRRL at Crowthorne was very strong and the potential for a network clearly exists. In deciding that Crowthorne should be the focus of initial attention, this is not to say that the other existing centres and schemes around the country should not continue and be given every encouragement; indeed the Crowthorne MAVIS can have a role in providing information on request to other establishments. In particular, there is a highly complementary role for the Banstead centre which is currently being discussed in detail by the interested parties.

It did seem, for the reasons given in 4 (e) above, that the quality of the resources which would be available at Crowthorne could not be reproduced elsewhere. This was important, for the first centre of a potential network should start with every possible opportunity to become a success.

Crowthorne is within two hours' drive of a quarter of the population of Britain and conveniently located between two major motorways for clients with private transport, although some provision has had to be made to cope with the problems of access by public transport. Both the British Railways station at Reading (about 10 miles away) and the trains using it are wheelchair-accessible, so a pick-up service, on demand, between Reading and TRRL is provided. A list of suitable overnight accommodation in the Crowthorne area is maintained and made available to clients.

6. THE SERVICES OFFERED AND PEOPLE ENTITLED TO USE THEM

It became apparent during the course of the feasibility study that any new centre would have to meet quite a wide range of needs if it were to offer a useful service to disabled people. It had to be more than just a driving assessment centre: some disabled people either cannot or do not want to drive but they may travel as car passengers, so they would benefit from advice. At a wider level, disabled people need specific advice on a range of transport services: on what is available, on how much it costs, on what services they may be able to obtain either free or at a reduced charge.

In planning the MAVIS, it was essential to draw on the experience of other centres for driving assessment and from organisations such as the Disabled Living Foundation (an advice and information service on all aspects of disability). This showed that all the available enquiry and information services were very heavily used. Thus the MAVIS was planned to encompass all aspects of mobility information as well as providing specific services for car drivers. It was, however, this last matter which produced the greatest amount of debate among members of the Working Group which was planning the MAVIS.

It was evident from a series of meetings with the people running other advisory centres that the nature of their service to drivers - and its underlying philosophy - varied from one place to another.

At the risk of oversimplifying, there are two ways of approaching the job of providing advice and help to disabled people. One way is to keep formal assessment of a person's ability to drive to a minimum and to work on the philosophy that if the person really wants to try and drive he or she should be allowed to have a go. The alternative philosophy argues that it is unwise to let a disabled person try to drive without first making sure that they are likely to be able to do so safely. In general, disabled drivers who are themselves involved with advising other disabled people favour the "have a go" philosophy. Those centres which are associated with medical facilities lean towards the "assess before they drive" approach to varying degrees.

Of course, the present advisory centres do not fall wholly at one extreme or the other, but there is nonetheless a clear divide in attitude between proponents of the two approaches.

The question remained: on what basis should MAVIS be established? Initially it was suggested that only those people with a provisional driving licence or a full licence not revoked by the DVLC should be allowed to test drive vehicles. Other disabled people could come to the MAVIS but would be limited to being assessed on static rigs or trying out parked cars for their suitability of access, seating, etc., without being able to drive them.

After considerable discussion it was finally agreed that the MAVIS should have a rig which would enable assessment of physical ability, dexterity and speed of reaction to be made, but that there should be no attempt to use quasi-medical assessments of either the ability to learn or of vision. To safeguard against problems which might arise if anyone who wished to drive one of the centre's cars were allowed to do so without the fuller range of assessment, it was decided that only those people who held a driving licence

(full or provisional) should be eligible for assessment. Thus the screening of people's medical fitness to drive remains the responsibility of the DVLC (the Driver and Vehicle Licensing Centre), through its Medical Advisory Branch. (See Appendix "DVLC medical screening procedure".)

There are several different areas of competence which ideally should be tested before a disabled person is advised that they are likely to be able to pass a driving test or to resume driving after becoming disabled. In summary, these are:

1. Physical ability and dexterity sufficient to give the person control over the vehicle, including maintenance of that ability over time.

2. Eyesight.

3. The ability to interpret changing external conditions.

4. Speed of reaction.

5. The ability to learn, reason and to remember.

The question then becomes a twofold one: how far is it possible to introduce tests which measure these areas of competence which can be carried out satisfactorily by non-medical people and, if it is not feasible to do this in all areas, does it actually matter?

The measurement of physical ability and dexterity can be made with the use of an instrumented rig. Provided that the person doing the assessment is adequately briefed on the levels of effort necessary to control a car, this can be carried out by a non-medical person.

Similarly, a Driver Vision Unit can be used by a lay person, once s/he has been shown how to operate it. This type of unit measures near and distant vision, peripheral vision, tunnel vision, colour perception and day and night vision. However, not all in the medical profession would accept that the use of this type of equipment would necessarily pick up all vision defects.

Vision testing is a particulary controversial topic, as it can be argued convincingly that disabled people (who are formally tested for driving skill in the same way as non-disabled people) should not have to undergo vision testing more stringent than that applied to other driving test candidates (who merely have to be able to read the 3 1/8 inch high letters of a number plate at 67 feet). Furthermore, there is no evidence that defective vision is a contributory factor in road accidents.

Speed of reaction can be tested in a straightforward manner and does not require any special medical training.

The ability to interpret external conditions and the ability to learn, reason and remember present more problems. It is not possible to make a formal assessment of these abilities without recourse to psychological testing and, therefore, to a medically qualified person. However, it may be argued that an experienced driving instructor would be able to identify anyone who suffered from such disabilities once s/he had taken them out for instruction.

The client could then be advised to go to a specialised assessment centre where a medically based evaluation could be made.

In addition to having a driving assessment and consultation on car adaptations, clients can also have vehicle familiarisation sessions. In these the client can drive any of the centre's cars on the private road circuit at TRRL so that they can become fully familiar with the vehicle and make an informed decision on whether it really suits them. Again clients must have a driving licence: a full one if they wish to drive unaccompanied, a provisional one if they are to be accompanied by the Driving Adviser.

7. FACILITIES, EQUIPMENT AND STAFFING

Having established the likely feasibility of the MAVIS and its methods of working, Ministerial approval was sought for the necessary funds and the project was approved in June 1985, with a targetted opening by the end of that year.

A building was found in the TRRL grounds, adjacent to the segregated Small Roads System. This is a purpose-road road network with all the features of British urban streets, including pedestrian crossings, traffic signals and roundabouts, hills and road junctions. However it is situated in a rural wooded surroundings, thus permitting simulation of urban driving without the associated hazards of a "real" town.

The building has been modified and adapted for use by the staff of the MAVIS and their clients, including people in wheelchairs. Repair work and modifications were carried out through the Government's Property Services Agency, and this represented the critical path in the establishment of the centre.

The MAVIS has been initially staffed with an Administrative Manager who had previously worked in the same field at DTp Headquarters in London, a Driving Adviser with previous experience of training and advising disabled drivers through a charitable foundation, and a clerical assistant. The selection and appointment of the Driving Adviser was also a matter of priority in establishing the centre, as his views were desirable on the details of the equipment to be supplied.

The full-time staff are supported by the fitters and mechanics of TRRL's own workshops. For example, a set of extending pedals have been made by the fitters to enable any of the MAVIS's fleet of cars to be driven by people of restricted growth; these were needed for one of the centre's earliest clients but are now available for future use. It is anticipated that other such adaptations and equipment will be devised as the clientele expands.

With the support of some British and foreign motor manufacturers, the MAVIS has been enabled to have a wide range of those new production cars which are most popular and appropriate for disabled car users; many were made available at reduced prices or on long-term free loan. The present fleet composition is shown in Table 1. Manufacturers and suppliers of adapted controls were also generous in supplying and fitting their products, in most cases free of charge. The fairly limited budget which was authorised for the launch of MAVIS was therefore able to be stretched across a wide range of vehicles.

Under the 1986-7 budget, it is planned to add the following vehicles and equipment: a Ford Transit van fitted with remote controls for driving and operating the doors and tail lift; a "Chairman" Metro conversion to carry a wheelchair-bound passenger; a Ford Escort 1600 cc Disabled Driver's version (to be bought to replace the current one which is only on loan); a Car Chair (a device which lifts wheelchairs in and out of the car, to enable wheelchair users to drive or be a passenger while remaining in their wheelchair) with 1 wheelchair and 2 access units, to be fitted either side of the Ford Escort; an Autochair wheelchair stowage unit, to be fitted to the Nissan Cherry; a Hodge wheelchair winch to be fitted to the Escort; a Parry personal hoist; a Guidosimplex steering aid to the fitted to the Renault 11; a new version sliding door to be fitted to the Renault 11; and a variety of cushions and back rests.

At the time of writing, one static driving assessment unit had been installed. This is effectively an instrumented car "front end" and measures clients' reaction time, and their range and strength of movement, thus assisting the Driving Adviser to form judgments on the clients' likelihood of being able to drive easily and safely, and on the most suitable combination of vehicles and adaptations to enable them to do so.

A second Hodge static assessment unit is in the budget to be purchased during 1986-7. This is likely to be mobile and/or based in the DTp Headquarters in Central London, to serve clients who only require a static assessment and who can reach Central London more easily than Crowthorne.

In addition to the above facilities for clients visiting the MAVIS, there is an extensive and growing database on all aspects of mobility, which is used to assist telephone callers and people making enquiries by letter. The data includes details of production cars, control adaptations and access aids, car financing and insurance schemes, concessions on taxes, parking, tolls and ferries in the UK and Europe, and many other aspects of mobility outside the field of private motoring: wheelchairs, small electric vehicles, specialist vehicles and vehicle conversions, special public transport services, concessionary fares and so on. One on-going project is to collate, for all current production cars and with the help of motor manufacturers, data on those measurements and features (e.g. torque and force required to operate primary controls) which have been established by consumer groups as being most critical when disabled people are choosing an appropriate car to travel in or drive. The database is indexed and summarised on the main DTp computer in London and is accessed through a desktop terminal at the MAVIS. In addition a considerable quantity of detailed printed literature is available for reference by staff and circulation to the public.

One final aspect of the facilities and work of the centre which should be mentioned, although it has yet to be developed, is the possibility of utilising the resources of the TRRL and its research work to enable MAVIS to become a national centre of technical excellence in the field of vehicle adaptation.

TABLE 1
THE MAVIS'S VEHICLE FLEET
May 1986

Make and model	Adaptations and equipment
Austin Mini City E 998 cc Automatic transmission	Single-lever push/pull hand controls on right, incorporating indicator switch. Quick-release hand brake on left.
Austin Mini Metro 1275 cc 5-door Automatic transmission	Steering Developments power-assisted steering. Ashley Mobility single-lever push/pull hand controls on right. Electric windows.
Fiat Uno 45 999 cc Manual transmission	Cowal vacuum servo hand clutch on right. Cowal single-lever hand accelerator on right. Cowal single-lever hand-controlled foot-brake on left.
Ford Escort 1597 cc station wagon	Reselco single-lever push/pull hand controls on right. Bekker steering ball at "10 o'clock". Indicators, horn and lights on steering ball panel.
(Special "Disabled Drivers Version" with automatic transmission)	
Ford Fiesta 1117 cc Manual transmission	Electric clutch on left. Bekker single-lever push/pull accelerator and brake. Chair-Up (wheelchair stowage unit) to be fitted.
Nissan Cherry 1270 cc Automatic transmission	Feeny and Johnson radial hand-controlled accelerator and brake on right and left.
Nissan Micra 988 cc Automatic transmission	Bekker single-lever push/pull accelerator and brake on right.
Renault 5 1397 cc Automatic transmission	Steering Developments' power-assisted steering. Feeny and Johnson servo-assisted single-lever brake and accelerator on right, and push/pull controls on left and right.
Renault 11 1397 cc Automatic transmission	Steering Developments power-assisted steering. Feeny and Johnson single-lever push/pull accelerator and brake on right. Electric windows.
Talbot/Peugeot 305 1580 cc Automatic transmission	Feeny and Johnson single-lever push/pull accelerator and brake on right. (available on loan but not kept at MAVIS)
Vauxhall Astra 1297 cc Automatic transmission	Ward single-lever push/pull accelerator and brake on right. Tilting steering wheel.
Vauxhall Cavalier 1598 cc station wagon Automatic transmission	Steering Developments joystick steering control on left and right. Steering Developments electric parking brake and power-assisted steering. (Can also be driven with standard steering.) Driver's seat height adjustment, tilting steering wheel.

8. DEMAND FOR ADVICE AND ASSESSMENT

Brief mention was made in Section 6 of the heavy use made of the other pre-existing information and advice services. As part of the planning of MAVIS, an analysis was made of the numbers of people using other driving assessment and advice centres in Great Britain. The quality and detail of records kept by these centres vary, but the results of the research, which are summarised below, show that where time-series data are available all aspects of the centres' work are increasing. In total during 1984 the centres carried out over 1,000 assessments of fitness to drive.

TABLE 2
USE MADE OF OTHER CENTRES

Centre/Year	Driving assessments	Car adaptations	Enquiries
Banstead			
1982	55	38	467
1983	169	99	1,232
1984	200	204	2,728
1985	227	208	3,987
BSM			
1984	259		
Cardiff			
1.3.84 - 30.11.84 (9 months)	164	-	
Derby			
1.4.82 - 31. 3.83	48	45	
1.4.83 - 31. 3.84	80	51	
1.4.84 - 31.10.84 (7 months)	129	110	
Edinburgh			
1984	(approx) 200		
Shrewsbury			
1984	12		n.a.[5]

These figures do not include the centre at the Northern Ireland Council for the Handicapped (which lies outside Great Britain, although it is in the UK).

It was also apparent that disabled people are prepared to travel considerable distances for assessments and advice on car adaptations. From the same data as was used to produce Table 2, it was found that approximately one-third of Banstead's clients for driving assessment lived more than 50 miles away as did more than 20 percent of their clients for advice on car adaptations. Thus MAVIS could be expected to draw clients from a wide area of the country, particularly given the national publicity which would attend its opening.

On the basis of the growth in demand experienced by all the other centres, it was estimated that MAVIS could expect to have up to 200 clients for assessment and/or adaptation advice in the first year of operation and that this could subsequently rise towards double that figure. No specific

forecast was attempted on the number of enquiries which might be received although, again based on the experience of other centres, these could be expected to be in the thousands each year rather than in hundreds.

As the MAVIS has been operating for four months (at the time of writing) it is possible to give some figures for what has actually happened. These are set out in Table 3. Over the 4 working months to the end of April, the centre had carried out 32 assessments, consultations and vehicle familiarisation sessions and had handled 375 enquiries. Of these enquiries just over half were from members of the public and a further 40 percent from professional individuals and agencies, or members of voluntary organisations.

TABLE 3
CLIENTS OF MAVIS

Activity	Dec/Jan[6]	Feb	Period March	April	May	Total
Driving Assessments	-	2	2	3	4	11
Consultations (on car adaptation)	-	2	4	6	5	17
Vehicle familiarisation	1	5	-	7	5	18
Enquiries by telephone	45	29	55	81	79	289
Enquiries by letter	33	44	20	34	20	151
Other enquiries	3	1	4	2	2	12
Visits by other than clients	6	4	6	8	9	33

Although the number of assessments etc., made to date is small the spread of disabilities of the clients is wide including spinal injury, stroke, arthritis, poliomyelitis, spina bifida, cerebral palsy and muscular dystrophy. Clients also chose to drive (or in some cases just to sit in and get the feel of) a variety of cars out of the MAVIS fleet and to the end of May all the 11 available had been used at least half a dozen times, and some models have been used several dozen times.

The initial period during which the centre was open was during a severe winter with snow lying for several weeks. This undoubtedly reduced the number of visits by clients but nonetheless, in comparison with the figures recorded at other centres when they first started, the numbers are encouraging. It seems probable that the first year will see something approaching 200 visits by clients and perhaps towards 1,000 enquiries for information by telephone and letter.

9. CHARGES

It is apparent from the costings that the MAVIS cannot hope to cover all its costs out of revenue. However, it is evident that people are prepared to pay reasonable fees for the services provided by other centres. The driving school mentioned in Section 2 charges £35 per hour for the assessments at its centre; Banstead charges £35 for a consultation on car adaptation and £75 for a driving ability assessment. Most other centres do not levy any charges.

The driving school approach of charging a rate per hour has attractions because it discriminates between straightforward assessments which can be done quite quickly and more difficult cases which take longer. Against this some people might be put off by not knowing in advance precisely what the cost of their assessment is likely to be. On balance it was considered that fixed charges would be preferred at least to start with, but this is being kept under review as experience grows. (The Driving Adviser keeps an accurate record of the time he spends with each client.)

Initially, the following levels of charges have been adopted:

Static assessment/advice on car adaptation:	£30
Full assessment including driving:	£50
Unaccompanied driving of the centre's cars:	£10/hour
General advice on mobility matters	Free

The static assessment fee was proposed so as not to undercut Banstead's and risk appearing to be in competition with them: the "full assessment" provided by the MAVIS is less comprehensive than Banstead's and the literature which describes the MAVIS's services makes this clear. However, it is hoped that both the charges suggested above and those at Banstead will be able to be reduced in real terms in the future. It is also hoped that some financial backing might be found to pay clients' fees in cases of hardship.

It must be stressed that, while these charges may represent significant sums of money to many disabled people, they are virtually insignificant compared with the costs of buying and running a car. Furthermore, if the service enables clients to make a more informed choice of vehicle and adaptations suitable to them, there may be savings in cost or better driving conditions for them, or both. At the extreme, if clients learn that they may not be able to drive safely and therefore would not be best advised to buy a car, then wasted expenditure is prevented.

10. THE WAY FORWARD

MAVIS is not only giving an on-going service to disabled car users, but is also already providing the opportunity to try new initiatives in the field.

A Forum of Advisory Centres has been set up so that all U.K. practitioners can meet at regular intervals to exchange their experiences and ideas. At the time of writing two meetings have been held, at different centres, and useful dialogue has ensued.

The work of MAVIS is being monitored over a three-year period, by means of interviews with clients and analyses of the service's records and procedures, to provide feedback on all aspects of the centre's work. At the time of writing the monitoring has barely begun, but it is hoped to present some early findings during the verbal presentation of this paper.

The monitoring should also indicate the feasibility of implementing some of the other potential developments of MAVIS's work such as the establishment of a national centre of research and development in car control design and technology[7], the formation of a focal point for information exchange and technical seminars, and other related avenues which are as yet at the stage only of a list of possible ideas for the future.

11. CONCLUSION

The clientele during the first few months of MAVIS's operation represent only the tip of the iceberg and the figures for the centre's use will be updated during the verbal presentation. Nonetheless, even at the time of writing it is clear that the MAVIS has got off to a flying start and that it is a positive contribution to increasing the mobility of disabled people.

The UK Department of Transport is firmly committed to this course and MAVIS is only one of a number of Government-backed initiatives to assist people with mobility handicaps, which are taking place in parallel and some of which are being reported elsewhere in this Conference and in the supporting book[8].

The Department's work is enhanced by its membership (and, indeed, by its providing the President) of the Working Group on Transport for Disabled People of the European Conference of Ministers of Transport, of which Canada and the USA are among the Associate Members. Again, the work of the Group is reported elsewhere at this Conference. The Ministers' Resolution of November 1985 calls specifically for measures to be taken by Member countries "to meet the desirability of providing assistance to disabled people for whom the purchase and operation of a car is deemed to be essential for their work or to enable them to live in the community".

The authors believe that the establishment of MAVIS is a further, and important, step towards this goal.

FOOTNOTES

1 Estimates drawn from an unpublished paper by Dr C.G.B. Mitchell.
2 See also Frye, E.A., "Mobility Allowance - its impact on the mobility of disabled people" in Mobility in the Global Village: a state of the art review of transportation for elderly and disabled persons, 1986.
3 "Visit report: Study Tour of Scandinavia, March 1983 - Adaptation of cars for disabled people and assessment of disabled drivers", C.G.B. Mitchell, TRRL (unpublished).
4 The findings of the following two paragraphs are based on individual Study Tour Visit Reports produced for each country by the UK Motor Industries Research Association.
5 There are unvalidated reports from Shrewsbury of approximately 13,000 enquiries being received each year.
6 The MAVIS was officially opened on 16 December 1985 but was not fully operational until 6 January 1986.
7 A contract to study the ergonomic requirements for adapted controls for disabled drivers has already been let by the TRRL.
8 Mobility in the Global Village: a state of the art review of transportation for elderly and disabled persons, 1986.

ACKNOWLEDGEMENT

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APPENDIX

DVLC MEDICAL SCREENING PROCEDURE

DVLC screening involves, in the first instance, a questionnaire to the individual asking them to specify their medical condition in detail and give the name and address of their family doctor, the names and addresses of any hospital specialist doctors they have attended and their consent for their doctors and specialists to give medical reports about their condition to the Licensing Authority.

These forms are screened in the Drivers Medical Branch according to a set of desk instructions.

The immediate options at this stage are:

(a) The medical condition or disability may be regarded as insignificant, e.g. the loss of a finger, in which case a "Till 70" licence is recommended.

(b) Further information may be required so that the case may be matched against the standards of the Medical Commission on Accident Prevention in their publication "Medical Aspects of Fitness to Drive". For example, a person may declare angina of effort and a questionnaire will be sent to the general practitioner asking clinically orientated questions about the nature of the angina and whether specifically it relates to the driving act.

(c) In complicated medical cases, hospital discharge summaries and relevant correspondence are accessed, with the individual's consent, through the GP or hospital specialist.

(d) Where the case is a complicated one it is referred to one of the 10 medical referees at the Licensing Centre who may decide that further medical investigations, e.g. a brain scan or E.E.G. or treadmill cardiographic testing, are required. In that case, arrangements are made for the test to be undertaken in a hospital convenient to the individual.

The ultimate decision as to whether a person can be granted a driving licence rests with the Medical Advisers at the Licensing Centre who act as a medical referee. In many instances an opinion of a general practitioner against a person driving is overruled by the referee. The referee has a number of options: to recommend the granting of a licence until the age of 70; to recommend a licence running for one, two or three years; or to recommend refusal or revocation of a driving licence. British driving licence legislation is unique in Western Europe in that it places an obligation on every driving licence holder to notify the Licensing Centre as soon as they become aware of any health condition which would affect safe driving either now or in the future. There is also a compulsory obligation to give consent to health reports being sent to the medical referees, failure to do so leads to withdrawal of the driving licence or refusal of an application for a licence.

The response to this driving licence legislation results in currently 900 notifications from applicants and drivers coming into the Licensing Centre for medical enquiry and investigation per working day. The legislation provides that a person who has a simple limb disability, e.g. traumatic amputation of a leg, has a right to a provisional licence for the purpose of trying a driving test so that the arbiter in these cases is not a medical practitioner but the driving examiner. However, where there is any progressive medical condition the arbiter becomes the medical referee.

CAR RESTRAINTS
FOR HANDICAPPED CHILDREN AND SMALL ADULTS

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CAR RESTRAINTS FOR HANDICAPPED CHILDREN AND SMALL ADULTS

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ABSTRACT

Restraint systems for able bodied children have become safer over the years. Federal standards ensure their safe performance while the provinces are responsible for enforcing their use.

Provincial laws have clauses exempting disabled children from a requirement to use a restraint system. Therefore, children and small adults unable to use a production restraint or seat belt or those who require a specialized seating device are often unprotected when riding in the family car.

This paper presents an estimate of the number of specialized car seats sold annually in Canada and examines the protection alternatives offered to people requiring special devices when travelling in a motor vehicle. It also presents the results of a dynamic crash test program conducted by Transport Canada. A number of special restraints for disabled children and small adults were tested as part of this program. The safety performance of the special restraints is analyzed with respect to the provisions of the child restraint regulations.

The results suggest that it would be possible and beneficial to prepare recommended guidelines or a standard that would increase the safety of the devices and encourage their use.

INTRODUCTION

The safety performance of child restraints have been regulated in Canada since 1974 by Consumer and Corporate Affairs. Transport Canada became responsible for the technical requirements of the regulations in 1980. The provinces have legal jurisdiction over the mandatory use of child restraint systems. Ontario was the first Canadian province to enact child restraint legislation in 1982. Others followed and today all ten provinces have similar legislation. Every provincial law state that a restraint used by a child must comply with the Canada Motor Vehicle Safety Standard (CMVSS) 213.1 (for infants) and 213 (for children) [1,2]*. They typically have clauses exempting

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* the number in square brackets indicate the references at the end of the paper

children who, for medical reasons or because of their size, build or other physical characteristics, are unable to use a conventional child restraint. A medical certificate from a physician would have to be issued for the exemptions.

In Ontario alone there is an estimated 8 000 children under the age of five with physical disabilities [3]. Many of them have special restraint needs when travelling in the family car. Commercially available restraints meeting the dynamic requirements of CMVSS 213 and 213.1 may be suited for some of these children. In other cases however, children or small sized adults requiring seating postural positioning devices are unprotected or are given little protection in the event of a crash.

Although CMVSS 213 and 213.1 do not presently address restraints for the disabled specifically, a specialty restraint can still be sold commercially if its performance satisfies the requirements of the standards. The standards can be divided in two main parts, the static requirements and the dynamic test.

The static requirements specify the strength of buckles, the energy absorption of the padding, the inflammability of the materials and the quality of the instructions.

The most stringent test to achieve compliance to the standard is a dynamic test. A dynamic test is conducted on a sled moving at a high speed and under going a violent deceleration. It would be impossible to require such a test in the case of custom made seating systems since the device is destroyed during the test. Two identical seats would have to be produced, one for the purpose of testing, the other for use by the disabled child. This is too expensive and involved considering the unique nature of the devices. Therefore, Transport Canada began to look at specialty car seats and postural devices that double as restraint systems for the handicapped.

Only devices that are designed to rest directly on the vehicle seat rather than wheelchairs and their tie-downs were given special attention. Extensive testing has already been done on the latter by renowned researchers. Similarly, wheelchairs are not covered by the child restraint regulations.

RESTRAINT SELECTION

Six rehabilitation centres were approached to participate in a test program. They were asked to provide Transport Canada with a custom made seating system typical of those they build for their patients. They were supplied

with the physical dimensions of anthropometric test dummies. Refer to Appendix "A" [5] for more details. Each centre was encouraged to build one or more devices using materials and techniques they most commonly employ. They were also asked to build the device for the size of test dummy most representative of the average size of their patients. Eleven custom restraints, including harnesses were supplied to us for testing. The photographs of some devices are reproduced in Appendix "B". A brief description of each custom made restraint is presented in Appendix "C". The description is based on an inspection of the seat or from the centre's literature [6].

Five production restraints, available in Canada or in other countries were also tested. They were the Britax (British made and available in Canada), the Rupert harness (United States), the Hansa booster cushion (Sweden), the Ortho-Kinetic Travel Chair (United-States) and the Tumble Forms Car Seat for older children (available in Canada). Photographs of these seats are in Appendix "B". For the production restraints, an anthropometric test dummy within the recommended weight range was selected.

Five harnesses with special features for the disabled were also tested. Some of them are also shown in Appendix "B".

The size of the test dummy used for each test and the method of attachment of each seat to the test sled is outlined in Appendix "C". The specifications for the dummies are given in Appendix "D".

TEST FACILITY AND EQUIPMENT

The Impact Facility of the Defence and Civil Institute of Environmental Medicine (DCIEM) in Downsview, Ontario conducted the dynamic tests [7]. The tests were performed in order to assess how each system performed with respect to CMVSS 213 and to determine any unusual structural failures or dynamic characteristics typical of those systems.

The tests were performed using a "12-inch HyGe impact accelerator" (Bendix Corp.), which simulates impact by rapid reverse acceleration. The crash deceleration is delivered to the test platform through the use of pressurized gas within the impact accelerator. An appropriate internal metering pin is selected for the desired pulse. The test sled, with its payload, is accelerated to a pre-determined

velocity with the restraint and dummy facing backwards. During this short period of rapid acceleration, the test set-up experiences the same dynamic loads that would occur during the sudden impact of a car with a fixed object. After the initial acceleration, the sled is slowly brought to a stop.

The deceleration pulse of the sled is specified in the Transport Canada Motor Vehicle Safety Test Methods 213 [8]. The acceleration profile was kept below the 20 g limit and the change of velocity was between 45.9 and 47.9 km/h.

The HyGe sled supports a platform to which a "standard bench-seat" is attached [9]. This seat is used throughout the industry for dynamic testing of child seats and adult restraints. Only one restraint was tested during each run. It was placed in the centre of the standard seat and was restrained according to the instructions of the manufacturers.

The basic sled acceleration data were monitored using two Setra, Model 14, high-output accelerometres mounted directly on the impact sled.

The seat-bottom and seat-back foam cushions of the standard seat were used for three and five tests, respectively, before being discarded. The foam to be reused was allowed to recover for at least 24 hours before another test.

A 500 frames per second high-speed Stalex rotating-prism motion-picture camera with a 13-mm wide-angle lens mounted on the sled was used to gather photographic data. It provided a lateral view of the restraint system and bench-seat. Information on dummy head excursion in the forward direction was obtained from the films captured by this camera with a commercially-available film-reader. A second high-speed movie camera was located directly in front of the restraint system.

Two Graph-Check sequence cameras are also used to provide event photographs of the impact.

The restraints were attached to the standard seat using the manufacturers' or the centres' instructions. Whenever possible, the standard bench-seat lap-belt, tether strap or other webbing were pre-tensioned to a value between 11 and 15 pounds, as specified in the Test Method.

TEST RESULTS AND COMMENTS

The dynamic requirements of CMVSS 213 qualifies as a failure a separation of any load-bearing member of the restraint, a partial separation exposing sharp edges or

protrusions of a specified size. The resultant acceleration of the chest must not exceed 60 g's for more than 3 milliseconds. Finally, the maximum head excursion of any point on the head of the 3 year old dummy, used for compliance testing to the standard, must not be more than 720 mm forward of a fixed reference point on the standard seat. The restraints in this program have not undergone static tests. The centres should be able to purchase complying materials from their suppliers.

Harnesses for able-bodied children are not permitted to be sold in Canada [10]. Transport Canada has previously tested harnesses for able bodied children that are commercially available in other countries [11]. A tendency for dummies restrained by these devices to "submarine" has previously been identified [12]. Submarining occurs when the shoulder straps pull the lap portion of the harness up over the hip's iliac crest. The dummy slouches and the lap portion of the harness penetrates the abdominal region. The high resultant pressure on abdominal organs can be injurious [13]. The determination of submarining is still only subjective as a reliable and repeatable objective criteria has not yet been developed.

The head excursion, the chest acceleration, the time the chest acceleration was above the permitted limit and a description of failures, or any unusual dynamic behaviour during sled testing are included for each restraint in Appendix "E". The event photographs for each test are reproduced in Appendix "F".

For the purpose of analyzing the results, the restraints that were tested in this program will be separated into three categories:

- custom-made seating systems;
- production restraint systems for the handicapped; and
- three-, four- and five-point harnesses.

Custom made seating systems

Seven custom-built postural positioning devices were tested during this program (#'s 1, 2, 3, 4, 6, 7, and 8). The other custom built devices will be treated as harnesses. Four of the postural positioning devices used a tether strap as part of their restraint system (#'s 3, 6, 7 and 8). Of the restraints that had a tether, only one (# 3) had a forward head excursion of 859 mm exceeding the limit set out in CMVSS 213. Even though restraint # 3 was very similar in design and construction to the untethered restraints (#'s 1, 2, and 4) in this category, its head excursion was an

average of 24 mm less than the untethered restraints. This was in spite of the fact that restraint # 3 was built for and tested with a 6 year old size dummy compared to a smaller 3 year old for the untethered restraints.

The other three tethered restraints passed the forward head excursion requirement. Restraints # 6, 7 and 8 had head excursions of 577, 602 and 485 mm respectively. The allowable limit is 720 mm. Two of these restraints were designed and built for a relatively large 50 th percentile male while the other was designed for a 6 year old child. However, these restraints exhibited a limited amount of "submarining". This problem might have been reduced by restraining the occupant and system separately (i. e.: by tethering the restraint rather than the shoulder harness). This would bring the three restraints in compliance with a sub-section of CMVSS 213 that states that "every belt that is part of the child restraint system and that is designed to restrain a child using the system shall, ... when ... tested (dynamically), impose no loads on the child that results from the mass the system ...".

The analysis of the results for the custom made restraints indicate that a special device benefits from the use a tether.

Of the seven custom seats, three of them exhibited some failures of the structure or of the shoulder and chest straps. Although velcro fasteners provide a rapid means for positioning a handicapped occupant lacking muscle tone or control, they do not appear to provide adequate protection in the event of an automotive crash.

The velcro fasteners on the shoulder straps of restraint # 1 separated. This is shown in Figure 1 of Appendix "G". It may have contributed to the relatively long head excursion of 912 mm. The problem with this particular restraint could be corrected by using a supplemental harness system with push button buckles for use in the automobile in addition to a velcro positioning system.

The right chest strap attaching to the back support of restraint # 2 ripped during testing. This is shown in Figure 2, Appendix "G". Such a failure might be corrected by using automotive fasteners and suitably strong stitching.

The head excursion of 871 mm for restraint # 2 could have been further reduced by using shoulder straps in addition to chest straps. Shoulder straps with push button buckles could be used only when the restraint is installed in the car should this be more practical.

A tear on the left side of the shell of restraint # 4 might be accounted for by several factors. The seat was built for a handicapped child slightly smaller than the 3 year old dummy. The restraint was also molded to the shape of the handicapped child and not to that of the dummy. Pressure not normally exercised by the dummy might have been placed on the sides of the restraint.

The frontal head excursion of 866 mm for restraint # 4 may also have benefited from the use of supplemental shoulder straps for automotive applications.

Restraints # 6, 7 and 8 did not exhibit any structural failures.

None of the custom orthotic seats displayed chest accelerations greater than the allowable 60 g's.

Production restraints for the handicapped

A total of four production restraints were tested. They were the Britax car seat (# 5), the Tumble Forms car seat (# 85-86/07), The Ortho-Kinetic Travel Chair (# 85-86/08), the Hansa booster cushion (# 85-86/09) and the Rupert harness (# 13). For the purpose of this analysis, the results for the Rupert harness will be treated in the next section under the heading of harnesses.

The tethered Britax car seat met all the dynamic requirements of CMVSS 213. Its frontal head excursion was 627 mm and the peak chest acceleration was 47 g's.

The Tumble Forms car seat also passed the dynamic requirements of CMVSS 213. Its frontal head excursion was 455 mm and peak chest acceleration was 45 g's.

As for the Ortho-Kinetic Travel Chair, its frontal head excursion and peak chest acceleration were 551 mm and 47.7 g's respectively. The head excursion in our test is less than a that of tests conducted by other researchers [14, 15]. This could be due to improvements made to the Travel Chair since the previous tests.

Similarly, the frontal head excursion for the Hansa booster was 437 mm while its peak chest acceleration was 39.1 g's. Some slight submarining was however recorded for this restraint. The final rest position of the dummy after the test is shown in Figure 3 of Appendix "H".

All the production restraints met the requirements of CMVSS 213. This was the case even when they were tested with dummies larger than the 3 year old dummy specified in the regulation.

Harnesses

Five harnesses were tested (#'s 9, 10, 11, 12 and 13). The first four were custom-designs from the same centre while the last one was the Rupert harness. Their main purpose is to restrain children in the family van.

All of the five harnesses tested performed within the head excursion limit of CMVSS 213. The head excursions were 442, 503, 391, 485 and 460 mm for restraints # 9, 10, 11, 12 and 13 respectively.

Two harness systems however, had peak chest accelerations over 60 g's for more than 3 milliseconds. They are restraints # 10 and 12 with times over the limit of 0.1 and 5.3 milliseconds. Their respective peak chest accelerations were 61.3 and 81.9 g's.

All the dummies restrained by harnesses had a tendency to submarine to some degree or to be restrained by the crotch strap where there was one. This further reinforces the results of previous testing done for Transport Canada.

The worst case of submarining is pictured in Figure 3 of Appendix "H". The penetration of the lap portion of the harness into the abdominal area of the dummy can be seen for the Rupert harness test.

The velcro on the upper and lower chest straps of the Rupert harness also became undone during the test. This should not have contributed to the submarining of the dummy but may have been as a result of it.

The three point harness of system # 12 restrained the three year old dummy by the neck (with the "Y" strap connection just below the neck) and at the crotch. Such a design has never previously been tested by Transport Canada. Potential injuries to the occupant would be due to the unique nature of this design. This condition is judged not desirable in any circumstances.

Finally, the aircraft type buckle of restraint # 9 could not be opened after the test.

CONCLUSIONS

The many thousands of young Canadians with disabilities and their parents, have a desire for safe transportation when travelling in the family car. It is estimated that approximately 3 500 specialized seating postural positioning devices are built or prescribed for disabled children and small adults in Canada every year. No estimates on the number of sales of production restraints or harnesses are available.

The specialized custom built systems are not presently covered by CMVSS standards.

Specialized postural positioning devices generally performed well in dynamic testing. The minor problems that occurred during the sled tests could be rectified by including items such as supplemental automotive shoulder harnesses and tether straps in the design of the restraint or by specifying the strength that velcro attachments must sustain.

Production restraints also performed well. All met the dynamic requirements of the standard. In only one case was there a minor submarining problem.

All harnesses restrained the test dummies in ways which were judged hazardous. Chest accelerations over the permitted limit in the standard were noted as were cases of severe submarining. In one case, the dummy was restrained by the neck. The results thus indicate that harnesses do not usually offer safety benefits and that they should not be permitted for the disabled as for able-bodied children until a repeatable submarining criteria is developed.

Recommended guide lines or a standard should be drafted to improve the safety of restraints for disabled children and small adults. The static requirements of the present standard should be extended to specialized postural positioning devices. Design oriented requirements should also apply to postural positioning devices eliminating the need for an expensive dynamic test. Seating clinics would benefit from the fact that they would be more aware of the safety requirements of restraints. The standard, including the sled test should be extended to production restraints for the disabled.

New standards would ultimately increase the availability of safe specialized custom or mass-produced systems and encourage their use.

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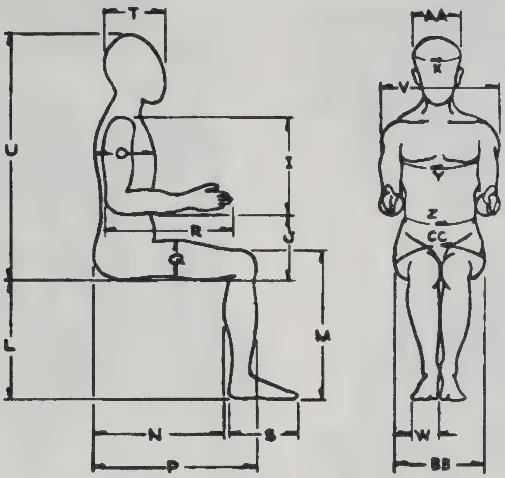
A P P E N D E C I E S

APPENDIX 'A'

TEST DUMMIES PHYSICAL DIMENSIONS



SYMBOL AND DESCRIPTION	DIMENSIONS (in inches unless otherwise specified) 3 year old child	6 year old child	5th percentile female	50th percentile male
Standing height	38.3	47.7		68.3
Weight	33.3 (lbs)	47.3 (lbs)	102 (lbs)	164 (lbs)
I-shoulder-elbow-length	6.8	9.2	12.5	14.1
J-elbow rest height (erect)	6.2	7.2	8.0	9.5
L-popliteal height		12.8	14.7	17.3
M-knee height (sitting)	10.4	14.5	17.6	21.4
N-buttock-popliteal length		13.6	17.0	19.5
O-chest depth	5.0	6.4	7.5	9.0
P-buttock-knee height	12.8	16.0	20.2	23.3
Q-thigh clearance	3.4	4.4	4.6	5.7
R-elbow-finger tip length	10.0	12.6	15.8	18.7
S-foot length	5.8	6.9	8.5	10.5
T-head length	6.7	7.0	6.8	7.7
U-sitting height (erect)	22.4	25.4	30.9	35.7
V-shoulder breadth	9.3	10.4	15.0	17.9
W-foot breadth	2.3	2.6	3.3	3.8
X-head circumference	20.0	20.7	20.4	22.5
Y-chest circumference	20.1	23.5	29.8	37.7
Z-waist circumference (sitting)		20.8	23.6	33.0
AA-head breadth	5.4	5.9	5.4	6.1
BB-hip breadth (sitting)	7.1	8.4	12.8	15.1
CC-hip circumference (sitting)		23.9	36.4	41.5

Figure 1 - Restraint #1

Figure 2 - Restraint #2

Figure 3 - Restraint #3

Figure 4 - Restraint #4

Figure 5 - Restraint #5

Figure 6 - Restraint #8
(similar to #6 and 7)

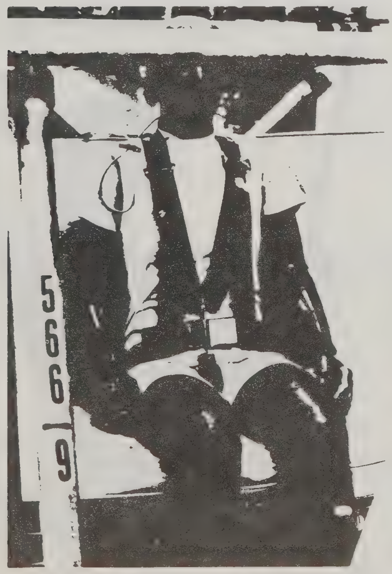


Figure 7 - Restraint #9
(typical of
Restraints #10 & 11)

Figure 8 - Restraint #12

Figure 9 - Restraint #13

Figure 10 - Restraint #85/86-07
Tumble Forms

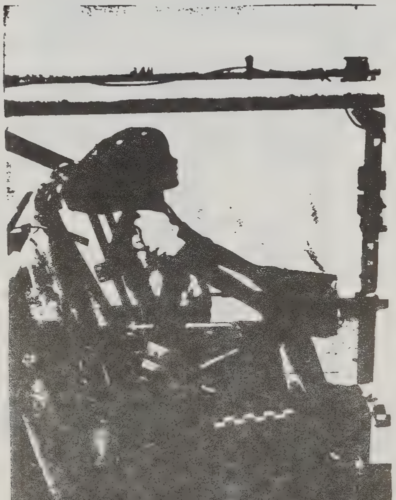


Figure 11 - Restraint #85/86-08
Ortho-Kinetic Travel
Chair

Figure 12 - Restraint #85/86-09
Hansa Booster

RES-TRAINT #	CENTRE	RESTRAINT DESCRIPTION	TEST DUMMY SIZE	ATTACHED TO SLED BY
1	I	plywood and vinyl covered foam, contoured adjustable head restraint, body supports - shoulder straps with velcro fastners to lab belt	3 yr	lap belt around restraint and occupant
2	II	ABS and vinyl covered foam, high back type head restraint - chest strap with velcro, lap belt	3 yr	lap belt around restraint and occupant
3	III	ABS and cloth covered foam, contoured adjustable head restraint - abdominal strap with velcro, lap belt	6 yr	lap belt around restraint and occupant and tether strap
4	IV	formed ABS and cloth covered foam, adjustable head restraint (removed for test) - chest strap with velcro, lap belt	3 yr	lap belt around restraint and occupant
5	N/A	production restraint, conventional construction	6 yr	lap belt through metal frame of restraint and tether strap
6	V	ABS and vinyl covered foam, contoured adjustable head restraint, shoulder straps with automotive buckles tethered to vehicle, lap belt guides, lap belt	50 % male	lap belt around restraint and occupant and tether strap
7	V	same as # 6 (562) but with floor mounted lap strap anchorage and shoulder strap clip	50 % male	lap belt around restraint and occupant and tether strap

7	V	same as # 6 (562) but with floor mounted lap strap anchorage and shoulder strap clip	50 % male	lap belt around restraint and occupant and tether strap
8	V	similar to # 6 (562) but with crotch strap	6 yr	lap belt around restraint and occupant, crotch and tether straps
9	VI	5-point harness	50 % male	wraps around seat with lap belt
10	VI	shoulder harness to side of hips with lap belt	5 % female	wraps around seat back
11	VI	5-point harness	6 yr	wraps around seat with lap belt
12	VI	three-point harness, no lap belt	3 yr	wraps around seat
13	N/A	Rupert production 4-point harness	5 % female	lap belt and tethered harness
85-86 /07	N/A	Tumble Forms production car seat, molded foam construction	5 % femal	three-point belt
85-86 /08	N/A	Ortho-Kinetic Travel Chair, production stroller converting to child seat	6 yr	lap belt through restraint frame and three-point belt around occupant and restraint
85-86 /09	N/A	Hansa booster cushion, production booster with 4-point harness	6 yr	three-point belt

- 3-year-old child, with a weight of 33 pounds (Model SA103C002, Humanoid System, Carsen, California, U.S.A.)

- 6-year-old child with a weight of 48 pounds (Model 572-6C, Alderson Research Labs, Stamford, Connecticut, u.S.A.)
- 5th percentile female with a weight of 101 pounds (Model VIP--5F, Alderson Research Labs, Stamford, Connecticut, U.S.A.).

- Hybrid II, 50th percentile adult with a weight of 165 pounds, (Model ATD30044, Alderson Research Labs, Stamford, Connecticut, U.S.A.)

APPENDIX "E"

RESTRAINT	STRUCTURAL FAILURES	PEAK CHEST ACCEL. (in g's)	TIME CHEST ACCEL. ABOVE 60 g's (pass or fail)	MAXI. HEAD EXCUR. (in in.) (pass or fail)	COMMENTS
1	velcro	N/A *	N/A	912 (fail)	the velcro on both shoulder straps separated, excessive restraint rotation
2	chest strap	31.7	0 (pass)	871 (fail)	the right chest strap became detached from the seat back
3	none	32.2	0 (pass)	859 (fail)	the energy-absorbing stitching on the tether broke, as intended
4	tear in shell	24.8	0 (pass)	866 (fail)	the left side of the restraint ripped (approx. 50 mm)
5 (Britax)	none	47.0	0 (pass)	627 (pass)	
6	none	47.0	0 (pass)	577 (pass)	some submarining
7	none	43.2	0 (pass)	602 (pass)	some submarining

8	none	49.0	0 (pass)	493 (pass)	some submarining
9	none	44.4	0 (pass)	442 (pass)	buckle could not be opened after test
10	none	61.3	3.1 msec (fail)	503 (pass)	chest acceleration over 60 g's for more than 3 msec.
11	none	59.3	0 (pass)	391 (pass)	occupant restrained by crotch belt
12	none	81.9	8.3 msec (fail)	485 (pass)	occupant restrained by the neck and crotch belt
13 (Rupert)	velcro	41.0	0 (pass)	460 (pass)	the velcro on the chest straps separated
85-86/07 (Tumble Forms)	none	45.0	0 (pass)	455 (pass)	
85-86/08 (Ortho-Kinetic Travel Chair)	none	47.7	0 (pass)	551	
85-86/09 (Hansa)	none	39.1	0 (pass)	437	slight submarining

Figure 1 - Time sequence photo for Restraint #1

Figure 2 - Time sequence photo for Restraint #2

Figure 3 - Time sequence photo of Restraint #3

Figure 4 - Time sequence photo of Restraint #4

Figure 5 - Time sequence photo of Restraint #5

Figure 6 - Time sequence photo of Restraint #6 (typical of Restraints #7 and 8)

Figure 7 - Time sequence photo of test of Restraint #9

Figure 8 - Time sequence photo of test of Restraint #10

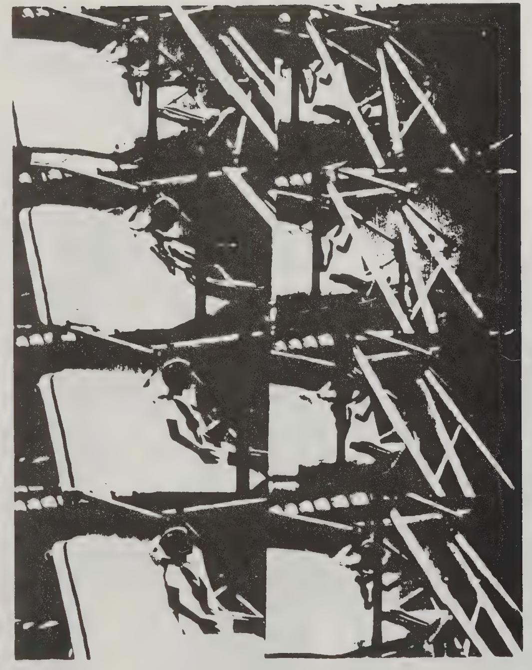


Figure 9 - Time sequence photo of test of Restraint #11

Figure 10 - Time sequence photo of test of Restraint #12

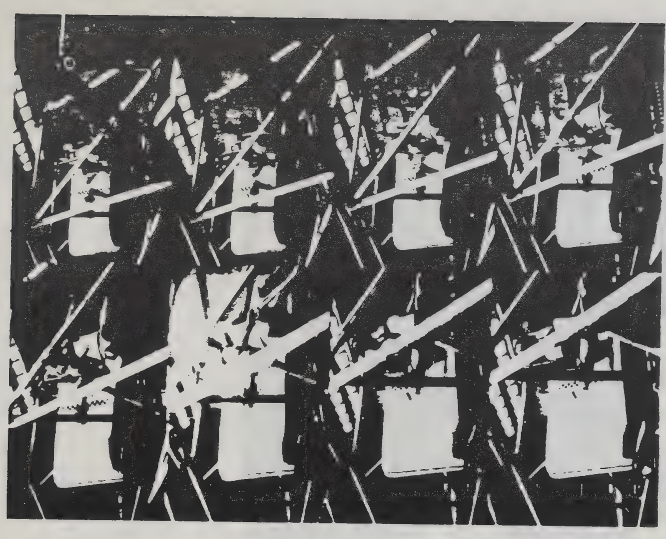


Figure 12 - Time sequence photo of Tumble Forms Car Seat

Figure 11 - Time sequence photo of test of Rupert harness

Figure 13 - Time sequence photo of test of Ortho-Kinetics Travel Chair

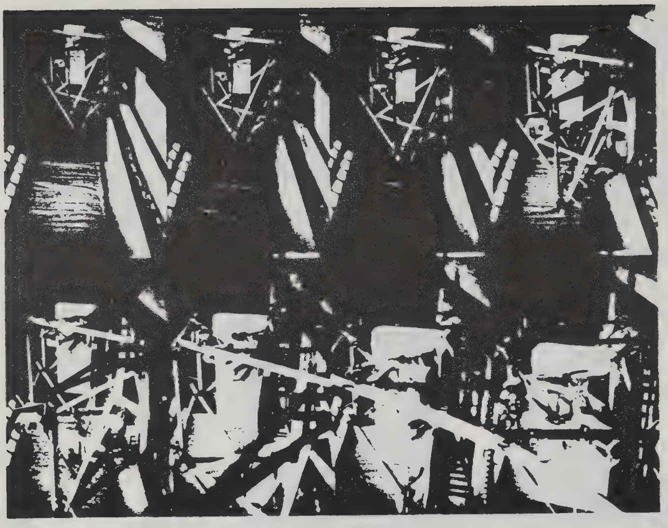


Figure 14 - Time sequence photo of test of Hansa booster

Figure 1 - Velcro fastener failure of Restraint #1

Figure 2 - Right chest strap attachment failure of Restraint #2

Figure 3 - Slight submarining of dummy in the Hansa booster

Figure 4 - Massive submarining of dummy in the Rupert harness

LICENSE RENEWAL FOR OLDER DRIVERS: THE EFFECTS OF MEDICAL AND VISION TESTS

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LICENSE RENEWAL FOR OLDER DRIVERS: THE EFFECTS OF MEDICAL AND VISION TESTS

David M. Zaidel

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INTRODUCTION

In many countries, the eligibility of drivers for driving licenses is periodically checked and reevaluated. The simplest form of license renewal is performed through the mail. Such a system can accomplish various administrative functions such as cleaning up of records in the agency's files, collecting revenues, or inducing drivers to pay up legal fines.

Many licensing agencies, however, institute more elaborate renewal systems which require periodic re-examination; these might include medical examinations, vision tests, knowledge and road tests (US DOT, 1984). Such renewal systems are intended to accomplish a screening function; that is, to identify drivers with a high accident potential in order to prevent or restrict their driving.

A common criterion for triggering a license renewal process is a driver's age. Thus, for example, the State of Maine mandates retesting drivers' vision at the age of 40, 52, and 65 onward. Several other states require periodic retesting, beginning at the age of 65, 69 or 70 (US DOT, 1984). Similar procedures exist in Australia (Drummond et al., 1983) and many European countries (LPRI, 1975).

The assumption underlying such an approach to licensing older drivers is that driver limitations and deficiencies are progressively more likely to affect drivers as they get older. Indeed, time induced impairments to many human functions -- memory, vision, alertness, health, etc., -- are well-known and not uncommon. Whether these impairments are necessarily related to actual driving performance or to a higher accident risk is still a controversial point, with the balance of evidence and opinions leaning against a strong relationship (Weiner, 1974; Naughton, 1980; Brainin, 1980).

Nevertheless, many license renewal programs focus primarily on older drivers and their suspected impairments. Some of these programs involve considerable administrative effort and cost, as well as cost and inconvenience for the drivers. It is appropriate, therefore, to ask how effective is the renewal process in screening out high risk drivers or improving safety in some other way.

Christensen, Glad and Pederson (1976) concluded that existing data do not support a positive safety effect of license renewal tests. More recently, Kelsey and Janke (1983) reported the results of an experimental program in the State of California where the standard in-person renewal process, which included vision, knowledge, and sometimes road tests, was replaced with an administrative license extension by mail. Drivers whose licenses would have expired in the coming year were randomly assigned either to a control group, who underwent the standard in-person renewal process, or to an extension group who could renew their licenses, without examinations, by mail. The results, based on 760,000 drivers, showed that there were no differences in violation or accident rates of drivers in the experimental program compared to the standard one. A follow-up study of 407,000 drivers (Kelsey et al., 1985) confirmed most of the previous results, especially with respect to the older (over 69) driver age group.

The study reported here examined the effectiveness of a license renewal program, based on vision and medical evaluation, in terms of its immediate and direct outcomes: How many drivers were reissued their licenses, what type of restrictions were imposed upon them, and what the reasons were for non-renewal of the license. It was found that following a protracted, costly and inconvenient renewal process, based on medical and vision tests, the licenses of practically all drivers of 65 years and upwards were revalidated. New driving restrictions were common, but usually of little practical significance.

THE LICENSE RENEWAL SYSTEM FOR ELDERLY DRIVERS IN ISRAEL

On reaching the age of 65, every driver is required to undergo medical and vision tests every two years. The license renewal form is sent to the drivers by mail. It consists of three parts: a vision test section to be completed by an approved optometrist or an opthalmologist, a medical examination checklist performed by a physician chosen by the applicant, and a medical questionnaire section to be filled in the presence of the physician.

The vision functions tested are static acuity under standard illumination and field of view. The medical examination and questionnaire deal primarily with cardiovascular impairments, diabetes, epilepsy, limiting physical deformations and other handicaps, mental disorders and medication. The completed form is sent to the central licensing office where it is processed. Forms with all negative findings (a clean bill of health) are processed in a routine administrative manner by clerical staff. Forms with positive findings are evaluated by physicians and the drivers may be asked to provide additional information or requested to be examined by the staff of the Medical Institute for Road Safety (MIRS).

Passing standards for corrected vision (20/40 in at least one eye, for passenger car license) are similar to those of most U.S. States and European countries (LPRI, 1975). Medical evaluation criteria also appear to be similar.

The possible outcomes of the renewal process for the individual driver are as follows:

a. a revalidated and unchanged license for a further two years;

b. the addition of driving restrictions;

c. downgrading of the license to a passenger car class only;

d. a requirement to be periodically retested at the Medical Institute for Road Safety;

e. termination of the driving license.

Drivers faced with outcomes b to e can appeal and argue their case with the authorities. The final decision of renewal rests with the chief of the licensing branch and not with the medical personnel.

METHOD

The study is based on a complete cohort of old (65+) drivers whose bi-yearly license renewal dates fell during 1980. Their computer records, their application forms with the medical and vision tests, and their files at the Medical Institute for Road Safety were traced and matched. The collated data were analyzed for test results and for the outcome of the renewal process. Supplementary telephone surveys explored the reasons for non-return of renewal applications, the driving habits of old drivers, and whether vision tests uncovered impairments which were unknown to the applicants.

RESULTS

The Renewal Process

Of the approximately 12,000 renewal application forms that were sent out during 1980, 10,937 (90%) were returned. On the basis of a supplementary survey, it was estimated that another 22% returned their applications late, thus increasing the return rate to 92%.

Table 1 summarizes the processing of the 10,937 forms returned on time. About half of the forms reported all negative findings and the corresponding licenses were renewed. Another 18% reported vision problems that could be corrected by eye-glasses. The corresponding licenses were renewed with an added restriction of "driving with glasses only."

Table 1 inserted here

Table 1: Completed application forms by license class and processing level

License class processing level	private	%	public service	%	Total	%
administrative no findings	5004	50.0	290	31.7	5294	48.4
correctable vision problem	1754	17.5	211	23.1	1965	18.0
sent to MIRS form evaluation	3109	31.0	206	22.5	3315	30.3
request for information	23	0.2	123	13.4	146	1.3
summoned for medical examination	132	1.3	85	9.3	217	2.0
Total	10022	100	915	100	10937	100

Thirty-four percent of the forms (3,678) were sent to the Medical Institute for Road Safety (MIRS) for further evaluation. In most of these cases (90%), the licenses were renewed, following an evaluation of the forms, sometimes with a restriction on the driver to wear eye-glasses. Only 3% (363) of the forms required extra handling. In 146 of these cases, extra information was acquired by mail. The other 217 applicants were invited to the MIRS for a medical examination.

As seen in Table 1, the renewal process for holders of public service licenses is much more stringent than for holders of private licenses. Twenty-three percent of the public service applicants were required to provide more medical information or to be examined by the physicians at MIRS as opposed to 1.5% of private license applications. It should be noted that vision and medical standards for a public service license are higher than for a regular license.

Outcomes

For 26% of the applicants, the vision and medical examinations resulted in an added driving restriction. The types of restrictions are described in Table 2. Again, holders of public service licenses were restricted more often than holders of private licenses. In almost all cases, the driver was restricted to wearing eye-glasses while driving. A mere 1.3% of the drivers were issued other restrictions, such as the use of a panoramic mirror, carrying certain medications, or appearing at the MIRS for periodic checkups.

Table 2 inserted here

In the study population consisting of all elderly drivers whose license expired during 1980, no private driving license was terminated by the licensing authorities. However, 30% of the public service licenses were not renewed. Half of these as a result of a vision impairment, and a third for other health-related problems. The remaining drivers voluntarily relinquished their higher class license.

Licensure Rate and Reasons for Non-Renewal

As already stated, 8% of the drivers did not return their forms and consequently did not renew their driver's license. This fact could imply a process of self selection, resulting from the medical examination procedure. In order to understand why licenses are not renewed, a telephone survey was conducted. The families of 142 drivers whose application forms were not returned were contacted.

The survey revealed that about half of the non-returns were accounted for by drivers who had died, while the other half had decided not to renew their driving license. On the basis of this survey, it is estimated that

Table 2: Restrictions added to the driving licenses

License class restriction	private	%	public service	%	Total	%
eye-glasses	2407	24.0	351	38.4	2758	25.2
panoramic mirror	24	0.2	1	0.1	27	0.2
periodic check-ups	54	0.5	37	4.0	91	0.8
others	15	0.1	7	0.8	28	0.3
Total	2500	24.8	396	43.3	2904	26.5

the licensure rate among elderly (65+) drivers in Israel is 96%. No more than 4% of the drivers due to renew their licenses chose to forfeit the license. The reasons for non-renewal were generally unrelated to the vision test and medical examination, but to a host of economic and health factors. Only 11% of those who chose not to renew their license stated that their decision was related to the renewal process itself.

Vision Impairment and the Renewal Process

As a result of the visual acuity test, 25% of the elderly applicants were required to wear eye-glasses while driving. However, this does not mean that the condition was new or that these drivers had been previously unaware of their vision problem. To investigate the true effect of the vision test, a telephone survey was conducted of a random sample of 220 elderly drivers who had a new eye-glass restriction added to their driving license. The interviewees did not know that the survey was related to their recent license renewal, and were told only that the subject of the survey was driving and vision problems.

Twelve percent of the persons interviewed had ceased to drive, although they continued to renew their license. Of those who <u>were</u> driving, 18% stated that they did not wear glasses while driving (although required by law to do so), and 39% of the drivers who wore glasses stated that they learned about their vision problem as a result of the license renewal procedure. Thus, it may be estimated that as a result of the vision acuity test, 7% of the elderly drivers started wearing glasses while driving (25% x 88% x 82% x 39%).

The drivers were also questioned about their driving habits. As mentioned, 12% did not drive at all, and another 35% drove less than 500 km. a month. Among those who drove, 60% rarely or never drove at night. The amount of driving declined steeply with age.

DISCUSSION

The study reported here followed up what had happened to the licenses of elderly drivers who underwent medical and vision examinations as part of the periodic license renewal process.

Over 90% of them returned completed applications and eventually had their licenses revalidated. This licensure rate is similar to the figures reported for California renewal programs (Kelsey and Janke, 1983). Of the remaining drivers, at least half died, and the rest did not re-apply because they had stopped driving and had decided to forfeit the license rather than go through with the renewal process.

None of the elderly drivers applying for license renewal were formally denied a license on the grounds of the medical results or the vision tests. However, 30% of elderly drivers who had previously held a public service license were issued a license to drive private cars only. Again, since most of these drivers had not been driving a public service

vehicle, the change would have no practical significance to them, or to the operation of public service vehicles.

The vision tests identified many drivers who required glasses to correct their visual acuity. However, most of them knew about their visual deficiency and had been wearing corrective lenses before the vision test. Nevertheless, about 7% of the drivers who underwent the vision tests and still drove were induced to start wearing corrective lenses whilst driving. Similar findings were recently reported by Rice and Jones (1984). In a screening study of 5,000 drivers, only 2.4% failed to pass a comprehensive vision test battery. The failure rate increased with age; up to fifty years it was less than 0.5%; between 51 and 70 it was 3%, while for drivers aged 71 and over, failure rate exceeded 13%. Nearly all failures were due to not passing the standard acuity test.

Other restrictions resulting from the medical tests were typically redundant in the sense that the affected drivers had been adhering to the restrictions anyhow.

There is a considerable degree of self-imposed curtailment or restriction of driving by older drivers, due to changes in life-style (e.g., retirement), economic reasons, medical and visual problems, etc. In general, they drive less and avoid particularly night driving. Brainin (1980) summarizes many similar findings.

In 1980, drivers of 65 years and upwards in Israel accounted for 3.1% of the driver population and for 2.7% of the injury accidents. As a group, they obviously do not constitute a menace to society. Yet, they were singled out to undergo frequent vision tests and medical examinations whose validity for road safety is still in question. Alternatives to the standard acuity test and additional vision tests "more relevant" to the driving situation have been advocated for many years (e.g., Henderson and Burg, 1974; Finlay and Wilkinson, 1984). Unfortunately, the evidence for their validity as screening criteria is even more scant, and practical measurement problems have yet to be solved.

The renewal process, the medical forms and the evaluation criteria used by the physicians at the MIRS are as good as could be expected on the basis of existing knowledge. The overall result was rather negligible and not very different from the outcome of a simpler and cheaper system requiring all drivers to make a health condition declaration on their renewal application (e.g., in Israel until age 65; in Britain, Taylor, 1974; Kelsey et al. 1985 in California).

It is apparent that the elaborate renewal process for older drivers helped the DMV to clean up and update its records, but it has had no impact as a screening device. The system has no proven diagnostic-remedial value (a role some authors would like to ascribe to it, e.g., Coppin, 1977; Waller, 1978) as it "discovers" impairments already known to the drivers. It is doubtful whether compulsory and costly medical examinations under the threat of losing a driving license are the appropriate context for diagnostic, preventive, public health type medicine.

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ELDERLY DRIVERS: EMERGING ISSUES

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ELDERLY DRIVERS: EMERGING ISSUES

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The older driver (SLIDE) definitely has a good safety record on our nation's roads and highways with respect to fatalities and injuries. There are today (SLIDE) approximately two and half million older drivers in Canada. Drivers aged 55 and over (SLIDE) make up 18 percent of the population and are only involved in 12 percent of all auto collisions. Comparing the older drivers record to that of the younger driver aged 16-24 years, we see a striking difference. Young drivers (SLIDE) represent 18 percent of the driving population but are involved in about 35 percent of all collisions.

On the surface at least, age and safe driving habits seem to go hand in hand (SLIDE). But a closer analysis of collision statistics reveal a different story. When the number of kilometres driven each year is factored into the equation, a striking pattern emerges. The resulting U-shape curve (SLIDE) tells us that drivers over the age of 60 are involved in more collisions than their middle-aged counterparts, when their record is based on actual kilometres driven. Collisions and traffic violations (SLIDE) among older drivers include: failure to yield the right of way; improper turning; incorrect lane changing; passing; entering and leaving freeways; and careless backing. Ninety percent (SLIDE) of older driver accidents are multiple vehicle crashes. They occur at lower speeds than of younger drivers and are less serious in terms of vehicle damage. But the likelihood of older people being injured or killed in any accident is much greater.

For a moment, let's examine the factors which contribute to these accidents, and the limitations which the older population experience which make them more vulnerable as drivers.

First, visual limitations (SLIDE). That is, the difficulty on focusing on a near object, the requirement for greater contrast between an object, and its background, which makes twilight driving very difficult by the lack of ability to see in the presence of glare, the inadequacy of their peripheral vision and, the length of time it takes to adjust visually from a lighted condition to one of darkness. Decline in all of these functions has been associated with the aging process.

Second, hearing loss and the ability to process auditory information shows impairment with increasing age. There is no conclusive evidence that hearing limitations per se impede safe driving performance. This is because what little bit of information is collected through hearing may be as easily picked up visually by drivers alerted to their auditory limitations. With the numerous visual problems associated with aging, older drivers may be physically incapable of using visual functions to take up the sensory slack of impaired hearing.

Third, movement-limiting disabilities such as rheumatism and arthritis are much more common in older people. Such disabilities may contribute to a tendency to swing wide before turning -- a practice which makes the turning movement less physically demanding but which also invites lane-sharing on the part of other drivers. Arthritic joints in the legs or arms may also make it difficult to react quickly to sudden changes in traffic situations. Stiffness in the neck makes it difficult to make head checks either when backing up or when checking the driver's blind spot.

Driving places critical demands on both short term memory and the ability to integrate and collate information from several sources simultaneously, both functions affected by aging. Therefore, older drivers have difficulty processing and reviewing cues to hazardous situations quickly enough to have time to react safely. Compounding this is an increased difficulty in filtering out unimportant visual information. Fixation on irrelevant objects and events can distract the driver making him or her more vulnerable to a hazardous situation.

Alcohol appears to affect people differently as they age. Older people frequently report that they can't hold their liquor like they used to. There is evidence to suggest that older drivers become unsafe drivers at lower levels BAC. Research indicates that blood alcohol levels above .05 percent impair performance requiring divided attention and skill necessary for coping with traffic. Such impairment, when combined with slower perceptual and motor speeds characteristic of the elderly, may be sufficient to account for an increase in injuries in older age groups even at lower alcohol levels. So while older drivers appear less likely to drink to excess than younger drivers, smaller amounts of alcohol appear to place them at substantially higher risk.

With this research information (SLIDE) on the older driver, the Canada Safety Council put together a 6 hour driver refresher course for older drivers called 55 ALIVE. The purpose of the refresher course (SLIDE) is to update driving knowledge, sharpen driving skills, and compensate for normal age-related changes in driving proficiency.

Session One addresses (SLIDE):

- characteristics of the driver,
- relevance of the curriculum,
- driving frustrations, and the
- effects of aging on driving behaviour.

Session Two addresses our physical changes (SLIDE):

- vision
- hearing
- physical movement
- reaction time
- effects of medications

Session Three deals with (SLIDE) visual perception and driving hazards.

Session Four discusses (SLIDE) the rules of the road, eg., yield right of way, turning, passing, etc. It also updates the participant as new/old road signs and markings.

Session Five addresses a number of defensive driving procedures (SLIDE) which enables you to remain collision and violation free.

Session Six spends time addressing (SLIDE) personal driving problems and driver licensing renewal regulations.

The course is primarily designed (SLIDE) to assist the older driver in maintaining his/her own personal mobility in the global village.

Provincial licensing authorities are presently looking into the need to establish stricter regulations governing re-licensing of older drivers. For example:

- New Brunswick Coroner's Report on the motor vehicle death of 5 elderly persons recommended that "on obtaining the age of 70, holders and applicants of driver licenses should be required to submit to a vision, written, and road test which would be required every two years".

- Ontario presenting requires a medical and road test if you are over 80 and annually thereafter.

- Provincial Transportation Ministries are investigating their re-testing procedures and regulations.

Our Council's concern is that if stricter licensing procedures are put in place, older drivers will not have the facilities available to prepare them for such testing. We believe that 55 ALIVE will provide this opportunity.

The course is taught (SLIDE) by certified classroom volunteer instructors, themselves being mature drivers. 55 ALIVE (SLIDE) is for you and me. It's a concept in driver refresher training (SLIDE) that is vital today -- and as the percentage of Canada's drivers in the over 55 age group increases.... one that will become even more important tomorrow.

AGING FACTORS THAT AFFECT THE DRIVING TASK

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General Motors Corporation

Fourth International Conference on Mobility and Transport for Elderly and Disabled Persons, Vancouver, July 20-23, 1986

AGING FACTORS THAT AFFECT THE DRIVING TASK

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INTRODUCTION

This paper examines what has been reported in contemporary literature about the effects of aging upon two basic functions that are especially involved in the driving task: the sensory function through which data necessary to drive safely are received and transmitted to the brain, and the cognitive function through which the data are processed and a decision is made to initiate some form of driver action.

THE EFFECTS OF AGING ON THE SENSORY FUNCTIONS INVOLVED IN DRIVING

Vision and hearing are the main sensory functions involved in driving a vehicle. Of the two, vision is the primary channel through which the brain receives data about what is taking place on the road outside the driver's car.

Vision

Seaton (cited in Winter, 1985) estimates that 90 percent of all sensory input necessary for driving comes through the eye. However, as the eye grows older, its various functions decline. The following discussion examines those changes that affect the visual functions significant to the driving task.

Accommodation: As the eye ages, it progressively loses its ability to focus upon near objects. Distant objects, however, continue to be seen clearly (Ophthalmology, 1978). Normally this decline in accommodation, called presbyopia, is unnoticed until a person passes the age of 40 and discovers that he has difficulty reading at the normal distance of 35 to 40 cm. Unless corrected by lenses, presbyopia can be bothersome to a driver when there is a need to focus upon displays and controls. There also is some evidence indicating that speed of accommodation; that is, one's ability to switch focus between near and far objects, declines with age (Cakir, et al, 1980). However, the available literature does not contain any research linking problems in accommodation to driving safety (Panek, et al, 1977).

Acuity: Also affected early in the aging process is visual acuity. Acuity is the ability to see fine details under normal illumination (Sturgis, 1981). It is measured by determining the smallest object a person can see at a pre-set distance which, for eye test purposes, has been set at 20 feet. The familiar eye chart is used to test acuity.

A visual acuity of 20/20 is considered standard. The denominator 20 indicates that a person with normal vision can see designated symbols clearly at a distance of 20 feet. An acuity of 20/50, on the other hand, means that a

person with this acuity sees at 20 feet what another person with standard vision can see at 50 feet.

Visual acuity of 20/30 to 20/70 is considered near-normal. That of 20/80 to 20/160 is moderate low, and requires strong corrective lenses for reading. Any person with 20/200 to 20/400 visual acuity is considered legally blind. Such a person would have difficulty reading signs or bus numbers if attempting to drive. (Ophthalmology, 1978).

Visual acuity improves between the ages of 20 to 30, levels off between the ages of 40 to 50, and begins to decline steadily thereafter (Pitts, 1982). When one reaches the age of 60, visual acuity is 25 percent less than what it was at 20 (Cakir, et al, 1980).

Illumination markedly affects acuity. For example, when viewing road signs lit only by headlamps, a person with 20/20 daytime vision may find that his visual acuity has dropped to 20/40. If vision tests for licensing were administered under such low light conditions and a visual acuity of 20/40 were the criterion for passage, nine of ten people over the age of 65 would be eliminated (Sturgis and Osgood, 1981). Pitts (1982) estimates that an illumination level comfortable to a person in his twenties must be doubled or tripled to be satisfactory to a person over 60. Other studies have shown that, under low light conditions, drivers over 64 demonstrate a mean corrected visual acuity of 20/140 (Panek, et al, 1977)!

Good daytime acuity, therefore, does not necessarily predict good nighttime acuity. In one experiment, Sivak, Olson and Pastalan (1981) subjected 12 persons under 25 and 12 over 65 having similar daytime visual acuity to controlled nighttime driving tests measuring sign symbol identity. Older subjects had to drive one-third to one-quarter the distance closer to the sign than younger subjects to make a correct identification.

Subsequently, using the same test setup, Sivak and Olson (1982) tested six younger and six older subjects having similar nighttime as well as daytime visual acuity. To their surprise, the mean approach distances for correctly identifying the symbol were the same regardless of age as long as it appeared on a background having high luminance contrast.

Static vs Dynamic Acuity: In recent years, researchers have begun to distinguish between static and dynamic visual acuity. Static acuity represents the clarity with which stationary objects are seen. A vision test based upon an eye chart is a good example of measuring static acuity. Dynamic acuity is the clarity with which objects are seen traveling at an angle to the viewer (Panek, et al, 1977).

Burg (1975), who has done extensive study in this area, believes that a test to perceive moving objects would be much more significant than the usual eye test administered within a driver licensing agency which measures only static acuity.

In one early experiment (1967), Burg tested 17,769 California drivers for dynamic visual acuity after they had completed licensing renewal exams, and compared the results against the static test scores and driving records of almost half this number. The dynamic visual acuity test scores appeared superior to the static test scores in predicting a driver's accident record.

Hills (1977) also conducted experiments in the sensitivity of vision to angular movement, and concluded that a definite deterioration of this function (dynamic acuity) did take place with aging, but static acuity (corrected) or simple visual reaction time remained relatively unchanged.

Visual acuity in the aging eye therefore betrays a sensitivity to the effects of low light, low contrast subject matter, and angular movement. In a normally lighted environment, however, an older person's acuity, when

corrected by proper lenses, appears satisfactory to the driving task.

Illumination: One of the more unique features of the eye is the lens. Unlike hair, skin or nails, it grows without shedding throughout its life (Fozard, et al, 1977). Thus new layers are continually being added to its outer surface. Eventually the build-up of layers reaches a thickness that affects the amount of light allowed to reach the retina where the image is formed that is transmitted to the brain.

Hughes and Neer (1981) have demonstrated that at age 50, a person experiences a 50 percent reduction in the amount of light reaching the retina. Sekuler (1982) uses the analogy that if one could measure the amount of light reaching the retinas of a 20-year-old and a 60-year-old, both of whom were reading the same book under the same light, he would find that the retinas of the younger man were receiving three times the amount of light as the retinas of the older man.

The decline in light transmission that older people experience does affect their capability to drive at night or in low-light conditions. Dark roadside obstacles, dark colored cars, and pedestrians in dark clothing, unrelieved by contrasting backgrounds, can present a difficult challenge. Fortunately, faced with this challenge, most elderly drivers voluntarily curtail their night-time travel.

Glare Sensitivity: Glare occurs when light scatters into the eye. If bright enough, it becomes superimposed over the image that is projected onto the retina to create a temporary blind spot, one that either overpowers or interferes with that image.

Glare can be categorized as either dazzling, veiling, or scotomatic (Carter, 1982). Dazzling glare is the overpowering glare experienced when bright sunlight is reflected off of a white, snowy landscape. Veiling glare appears like a "double exposure". The reflection of an instrument panel in the driver's windshield is an example of veiling glare. Scotomatic glare is a momentary exposure to an intense bright light such as the brilliance of a triggered flash bulb or of the upper beams of an approaching car's headlamps. Both create an after-image that temporarily blocks further vision after the light source is gone.

As the eye ages, glare seems intensified, and its after-image prolonged, slowing one's ability to recover from it. Studies have concluded that the thickened lens and reduced pupil size are the cause (Fozard, et al, 1977). It is common for scotomatic glare to affect aging persons at light intensities that do not affect the young (Carter, 1982).

Sensitivity to glare becomes recognizeable at about the same time that a person discovers the need for reading glasses, but the increase in discomfort that is experienced is gradual. Pastalan noted wryly in one of his studies (1975) that although none of the six elderly drivers he was road testing admitted to any difficulty with glare and never drove directly into the sun, still, five of the six used their sun visors.

Glare recovery has been of particular interest to scientists researching the aging driver. Burg (1975), for example, measured the glare resistance of several thousand drivers aged 16 to 92, and concluded that the time required to recover from glare exposure increased progressively after the age of 40. His tests produced a glare recovery time of 6.04 seconds for males aged 65 to 69 versus only 3.75 seconds for males 16 to 19. Pulling, et al (1978) exposed 148 subjects of all ages to a replication of typical headlight glare conditions in a driver simulator, and discovered an average deterioration in glare resistance equivalent to 50 percent every 12 years.

Wolbarsht (1977) characterizes glare as looking at a bright light through a dirty windshield. Older people with glare problems thus have eyes with built-in, dirty windshields. Wolbarsht claims that if glare sensitivity is increased by a factor of 10, visibility is reduced by 80 percent, a condition that typically occurs when one drives in the rain. And Runar (1977) reports that the reflection of low beams off a wet, smooth road is five times as intense as its reflection off a dry road.

Still, despite the excellent research on glare disability that has taken place thus far, the effect of glare on driving safety, especially as it involves the aging driver, is speculative at best.

Contrast Sensitivity: Normally it is common for older people to have difficulty seeing objects that are poorly lit or have low contrast, especially if they are backed by a very bright background like the setting sun (Carter, 1982). Research in this area, however, is scanty. Pitts (1982), for example, found that low contrast subjects require over twice as much light if older persons are to see them with the same degree of clarity as younger persons. Blackwell and Blackwell (cited in Hughes and Neer, 1981), after measuring the contrast sensitivity of 150 volunteers aged 20 to 80, determined that an object must have 3.51 times greater contrast if an older person is to see it as well as a 20-to-30-year-old. However, there appears to be no research relating contrast sensitivity to driving safety.

Dark Adaptation: The human eye adjusts to very wide differences in light intensities through a process called adaptation. However, as the eye ages, it experiences a decrease in pupil size. This decrease, coupled with the thickening of the lens, reduces its ability to adapt easily and quickly when changing from dark to bright environments (Pitts, 1982), and in fact, may result in a momentary loss in visual acuity, depth perception, and color sensitivity (Fozard, et al, 1977).

Wolbarsht (1977) cites studies indicating that dark adaptation is about the same for all normal people. He believes that it is an unimportant factor in night driving because of the effective headlighting that vehicles have today.

There does not appear to be any research relating a decline in the adaptation process to driving safety.

Depth Perception: Depth perception is the ability of a driver to determine changes between his vehicle and other moving or stationary objects. Sometimes called stereoscopic vision or stereopsis, it can be affected by several factors such as susceptibility to glare, loss of visual acuity in darkness, and the illumination, contrast and color of the object under view. Fozard, et al (1977), after reviewing several experiments in depth perception, have concluded that the most significant shift takes place between the ages of 40 and 50, or about the same time that people need reading glasses.

Hill and Mershon (1985) believe that an internal, organizing factor called the Equidistant Tendency comes into play when environmental cues are weak, providing individuals with an additional "sense" of depth. They attribute a decline in an older person's depth perception to his having a problem with his Equidistant Tendency.

Panek, et al (1977), after extensive search, were unable to discover any studies examining the effects of depth perception on the driving task.

Peripheral Vision: It may be that peripheral vision is one of the few

visual functions for which reasonable compensation exists - one need only turn his head from one side to the other to compensate (Panek, et al, 1977). Burg (cited in Carter,1982) has established that the lateral width of a person's field of view maximizes at age 35, then declines. One study has this decline reach about four percent by age 70 (Journal of Traffic Medicine, 1975).

The significance of peripheral vision to driver safety has never been clearly established. For example, Council and Allen (1974), after measuring the visual fields of 52,000 drivers of all ages and plotting them against the subjects' accident records, recommended against including any such measure in driver licensing tests because they could find no significant evidence that narrower visual fields were related to accident involvement.

Color Sensitivity: As the eye ages and the lens thickens, colors appear less vivid and bright. Also, the lens yellows, thus making it increasingly insensitive to colors of shorter wavelengths, particularly blues (Murch, 1985). The aging eye thus looks out at the world much as a younger eye would if covered by a yellow filter; that is, yellows and oranges are accentuated and whites turn yellow, while blues, blue-greens, and violets appear darker (Carter, 1977). A satisfactory explanation of the yellowing process still has not been discovered.

Dalderup and Fredericks (cited in Fozard, 1977), observed a general loss in color sensitivity among nursing home subjects aged about 70, while those aged 90 could identify less than 50 percent of colors correctly.

However tempting it may be to speculate about the effects of deteriorating color perception on the driving task, one must recognize that a relationship between this decline and the driving behaviour of the elderly has yet to be investigated.

Hearing

Hearing, like vision, also experiences a natural loss through aging. Called presbycusis, this decline first becomes noticeable in men after the age of 32, and in women after the age of 37. Hearing loss, in fact, ranks second only to arthritis as a chronic condition of aging (Corso, 1982). The rate of loss, however, varies with the individual.

Panek, et al, (1977) and Corso (1982) have conducted extensive reviews of the literature that document a decline in sensitivity to high frequency sounds and pure tones as a person ages. Older people also have more difficulty in understanding normal conversation if a number of phonetically similar words are being used, and if the conversation takes place within a noisy environment. It is better to talk at a moderate rate of speed to an aged person, in fairly low tones, and within an environment where competing noise is low, otherwise the meaning of what is being said will be lost (Winter, 1985). Feldman and Roger (cited in Corso, 1982) have discovered that one's ability to discriminate speech is stable up to age 50, but declines 25 percent by age 80.

Except for a few examples, research has failed to address the effect of hearing loss upon driving safety. Planek and Overend (1973) mention a California study of the violation and accident records of deaf drivers in which deaf males had significantly more accidents than their non-deaf counterparts in city traffic, but the same number of convictions. On the other hand, the record for deaf female drivers was no worse than that of non-deaf female drivers.

Much of the literature's focus on the effect of hearing loss seems to be

attitudinal. According to Winter (1980), the consensus is that hearing loss is not a serious handicap to driving as long as one exercises caution and is relatively alert. And in testifying at the Hearing on Elderly Driver Issues (1984), Schneider mentions that foreign cars have very high frequency horns while those of American cars have low frequency which make the latter, in his opinion, safer. He would advocate a regulation requiring that all automotive horns have a low frequency decibel sound recognizeable to persons over 70.

Thus the effect of hearing upon the driving task does not seem to be clearly established in the literature. In fact, Poulton (1972) claims that healthy people need not worry about the normal hearing loss associated with aging since the sounds that matter usually are well above the threshold of hearing.

EFFECTS OF AGING ON THE COGNITIVE FUNCTIONS INVOLVED IN DRIVING

The cognitive or decision-making process involved in the driving task can be characterized as a continuing series of events in which a driver perceives the changing traffic conditions around him, develops responses to them, selects the most appropriate responses, and acts.

The literature is fairly consistent in indicating that older people need more information than younger people in order to make a decision, more time to select an appropriate response, and more time in which to respond (Planek and Overend, 1973, and Panek, et al, 1977). Braune, et al (1985), for example have studied the responses of 60 persons aged 20 to 60 under nine different information processing tasks that took into account memory, hearing and vision. Response time for task completion increased systematically with age.

Earlier research into the performance of older people seemed to indicate that their decline in response time was due to the effects of aging upon vision, muscles and joints. But in the past 20 years, research has been converging upon the theory that the slower reaction times of older adults result instead from a decline in the central function of the brain (Traffic Safety of Elderly Road Users, 1985).

Welford's explanation of the slowing-down function (1977, 1981) is that the strength of the signals older people receive through the senses is weakened with age. They therefore tend to inspect those signals longer to be certain of their identity before deciding to act. Older people also have the tendency to monitor their responses as they go along which diverts them from immediately preparing for the next signal. Thus a new signal arrives just as a response to the last signal is being completed, competing with it for attention. On the other hand, if there is no need for a quick response, an older person can take as long as necessary to inspect incoming signals, thereby performing tasks safely and with a high degree of accuracy. The same holds true if the response can be planned well in advance or involves a reaction made out of habit.

Welford's research correlates with earlier studies indicating that older people work best at tasks over which they control response time, and not as well at tasks whose pace is forced by a machine. Also, if not rushed, older people perform better than younger people at tasks to which they can put their past experience to use (Poulton, 1972).

Some experiments have been carried out attempting to relate slower response time to the driving task. A major effort was reported by Rackoff (1974) who exposed 10 subjects aged 21 to 29 and 13 aged 60 to 70 to a battery of laboratory and driving tests to see what differences between the two age groups would emerge. The results showed that the older drivers took much more time to acquire sufficient information to control their vehicles,

spent less time looking away from the road, and drove several miles-per-hour slower - all of which correlated with the lower capacities they registered in associated laboratory tests. They also tended to underestimate driving speeds when not using the speedometer. Rackoff further concluded that older drivers may not be driving as slow as they believe, therefore could be skimping on the time allowed for decision-making.

Another study saw Allen and his associates (1980) investigate problems that elderly drivers might encounter with symbolic road signs. The researchers took 60 drivers aged 21 to 79 through driver simulator tests in which they were shown 72 different signs while traveling 55 mph. Test results revealed that initial symbol knowledge decreased with age, but that older drivers had no special problems learning and retaining new symbols. On the other hand, the distance at which subjects first recognized the sign symbol decreased significantly with age. They recommended that sign symbol training be required of licensing procedures, and suggested that sign placement take into account the longer processing time that elderly drivers experience.

Vigilance: An important facet of the central processing system, particularly for drivers, is vigilance; that is, the readiness of an individual to respond to sudden, unpredictable, infrequent changes in signal that call for quick responses. Studies by Surwillo and Quilter (cited in Quilter, et al, 1965) and Mackworth (1968) have established that persons of middle age have the fastest voluntary reaction to infrequent signals, while the young and old have the slowest.

A significant study saw Quilter, Giambra and Benson (1983) measure changes in vigilance in the same 33 subjects after an 18 year period. Test results indicated a pronounced decline in vigilance in those persons who had reached or exceeded the age of 70 by the time that the second test was conducted. Reaction times were much slower, and 58 percent fewer cues were identified. The researchers concluded that at about the age of 70, a noticeable decline in vigilance begins to take place.

Problem Solving: Studies document a slowing-down of an older person's ability to solve complex problems. Pastalan (1976) believes that the young use a trial-and-error method for problem solving, sampling different responses rapidly before settling upon the one that is most appropriate. Older persons, usually unable to take such a rapid sample, prefer instead to delay acting until they are certain of a single, correct response. This inevitably produces a longer response time.

Arenberg (1974) exposed the same 224 people aged 24 to 87 to the same battery of problem solving tests taken six years apart. The results indicated that a person's ability to solve complex reasoning problems declines after the age of 70. Subsequently, Arenberg (1982) conducted a follow-up study that confirmed his original findings; however, he also discovered that in some cases the performance of older people can be improved without training once they become familiar with the task through practice.

In an early study conducted by Case, Hulbert and Beers (1970), one group of drivers under 51 and another over 51 were given several performance and judgmental tests which included the use of UCLA's Driving Simulator Laboratory. The conclusion they reached was that a driver's judgmental skills do not decline until senility, and most aging drivers change their driving habits effectively in response to declining motor skills. Further, since so much of driving is a self-paced task, they felt that elderly drivers normally have the time or make the time to exercise good judgment; however, they expressed concern over the capability of an elderly driver to exercise

similar good judgment in the face of a rapidly changing traffic situation.

Memory: The typical model of memory has incoming information pass briefly (no more than two seconds) into what is called a sensory memory store, then into short term memory (STM), sometimes called primary memory, where its stay can be from two to 30 seconds before decay takes place. (An example of this process is looking up a telephone number, remembering it long enough to dial, then forgetting it.) From short term memory, information passes into longer term memory (LTM), sometimes called secondary memory, if a person desires to retain it for any length of time (Ordy, Brizie, and Johnson, 1982).

Birren (cited in Poulton, 1972) has demonstrated that the short term memory store of an older person has less capacity than that of a younger person. His experiments attribute an average memory span of six digits for men over 65 versus seven digits for men 18 to 30.

Waugh and Norman (cited in Wellford, 1981) have concluded that short term memory can retain only two or three items at any one time, and any new addition forces one of them out so that it is either lost or passed on to long term memory.

Craik (1977) argues that long term memory is the function most affected by aging, not short term memory. There is mixed agreement on this point.

In one attempt to put the matter to rest, Bacon, Wilson and Kraszniak (1982) compared the memory scanning rates of 12 young and 12 elderly subjects, all of whom were in good health. Their results were consistent with Craik's (1977) view that short term memory is relatively unaffected by aging. Further, there was little difference between the two groups in scanning speed or accuracy.

Welford (1981) has proposed a memory model suggesting that any short or long term memory weaknesses of the elderly stem primarily from their failure to transfer items from short to long term memory when necessary, a failure that is due to their learning processes, not age. He believes that once the elderly learn the necessary material, their retention of it is almost equal to that of the young.

Rackoff's (1974) experiments in tracking and delayed response have led him to conclude that short term memory can be greatly affected if interrupted by an intervening activity. Further, he found that the ability of older people to do two tasks simultaneously declined substantially if one of the tasks was a memory task.

Experiments have pointed to a decline in visual memory with aging (Miller, 1979). Arenberg (1978) cites several studies reporting that older adults commit more errors than the young in recalling pictorial designs. In his own study, Arenberg compared the performance of 268 men of all ages taking the same test for reproducing geometric designs from memory six years apart. Two-thirds of the men who passed the age of 70 after taking the test the first time did worse six years later, while only half of the others turned in a poorer performance. Arenberg concluded that memory for design begins to decline substantially after the age of 70, although memory for verbal information does not, which means that a general decline in cognitive performance cannot be attributed to aging.

Riege and associates (1981) question whether memory-for-design tests can produce general conclusions about visual memory. They point out that such tests are primarily used as a screening device for people with brain dysfunctions, and typically measure recall of designs common to brain impairment. Based upon their own experiments with memory for design, they concluded that a memory-for-design test says little about a person's memory.

Further, they noted that the performance of older volunteers whom they tested did not differ from the performance of others when it came to items easy to remember.

Nevertheless, based upon his work with subjects involved in the Baltimore Longitudinal Study, Arenberg (1983) is adamant in his view that memory and learning do decline with age.

Thus there are differing conclusions about the performance of elderly people in memory tasks. Therefore it might not be appropriate to attribute any poor driving on their part to memory deficiency.

SUMMARY AND CONCLUSIONS

Based upon the research literature reviewed for this paper, the aging driver emerges as a person who initially begins to experience difficulty with vision and hearing, then gradually a slowing down in his decision-making capabilities.

While these general observations can be made, it is difficult to avoid drawing the conclusion that studies correlating known aging deficiencies with the driving task are scanty which makes it extremely difficult to propose changes in the vehicle, road, or environment that would have predictive, direct benefit.

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RESEARCH AND POLICIES OF THE FEDERAL HIGHWAY ADMINISTRATION RELATING TO THE ELDERLY

by

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Research and Policies of the Federal Highway Administration Relating to the Elderly

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Federal Highway Administration

The Federal Highway Administration (FHWA), an agency of the U.S. Department of Transportation, is responsible for developing policies and conducting research that relate to the planning, design, and operation of roadways constructed and maintained with Federal funds. FHWA is concerned with issues such as roadway design (e.g. width and number of travel lanes, radius of curvative, etc.), bridge design, and highway operations (e.g. signs, signals, and roadway markings). The accommodation as well as the safety of all roadway users is of primary interest. Another agency of the U.S. Department of Transportation, the National Highway Traffic Safety Administration or NHTSA is responsible for safety related issues of national interest that deal with driver licensing and testing, law enforcement, and the design of safe vehicles. My talk will be restricted to topics relating to the roadway and how it is designed and operated for use by elderly drivers and pedestrians.

Roadways are designed to be used by all licensed drivers and pedestrians. The elderly, although a very diverse group, are one category of road user that is receiving increasing research and policy interest at FHWA. The future growth of the amount of travel by the elderly due to population projections and greater personal mobility has been well documented. Research has been conducted to determine the capabilities and the limitations of older drivers, and how the roadway system can accommodate these users. Driving is an important part of the social and the psychological functioning of many elderly persons. As individuals age, they tend to compensate for developmental changes by driving shorter distances, travelling at slower speeds, avoiding heavy traffic whenever possible, driving during daylight hours, and, in general, attempting to avoid stressful driving situations. Elderly pedestrians often walk more cautiously and avoid locations they feel are particularly hazardous. Elderly drivers and pedestrians are adapting their behaviors on the roadway, but how can the roadway be adapted to the needs and the capabilities of these persons?

Research Issues

To date, FHWA has conducted several research studies on the safety and accommodation of elderly travellers: One study[1] identified highway design and operational standards that are sensitive to driver characteristics (including aging). The study concluded that the standards relating to the geometric design of the roadway (e.g. stopping sight distance and intersection sight distance calculations, horizontal curvature, decision making, and design of railroad grade crossings) should consider changes in the age of the driving population. Similarly, standards relating to traffic control such as pedestrian and vehicular signal timing and color, and letter size and color for signs should consider the changing age composition of the U.S. travelling public.

A second research study[2] identified problems associated with elderly drivers' use of symbolic road signs. The effects of age, training, and sign format on the learning and retention of symbol knowledge were measured. The symbolic signs used in the study are those used to replace word messages along the highway. It was found that older

drivers do not appear to have problems in learning and retaining symbol sign knowledge. Older persons do display less current symbol sign knowledge which may be due to lack of familiarity with particular signs. Older drivers do require more time to process information presented on symbolic signs and therefore, more complex symbolic signs prove to be more difficult for elderly drivers to quickly interpret and act upon.

A third research effort[3] which was entitled "Traffic Control Design Elements for Accommodating Drivers with Diminished Capability," is about to be initiated. This research will determine the extent to which drivers with limited abilities are being accommodated by the current generation of traffic control devices. Elderly drivers with diminished capabilities will be included in the study. Problem identification will be the initial task. Laboratory and field experiments will be conducted in three areas: (1) sensory-perceptual capacity (i.e. vision), (2) cognitive capacity (i.e. information processing, memory, cognitive processing, etc.), and (3) motor response capacity (reaction time, eye and head movement, etc.). Critical tradeoffs in adapting traffic control devices to meet the needs of these persons as well as other road users will be made. The goal is to determine how traffic control devices can be modified to assist persons of diminished capability of any age.

FHWA is also contributing to the Transportation Research Board's study to improve the safety and mobility of older persons. This study will evaluate existing data; recommend improvements in highway practice, vehicle design, licensing, testing, and educational activities, and identify areas needing further research.

In conjunction with the Organization for Economic Cooperation and Development, and the World Health Organization, an international study[4] of the safety of elderly road users was conducted. European and North American countries share concern over this area and have similar problems. The study investigated socio-demographic trends, travel patterns and accident of elderly, psychological and physical changes affected by aging and educational, environmental, and legislative measures to enhance travel by the elderly.

In the area of research on the elderly as pedestrians, FHWA has conducted several efforts: One study, "Provisions for Elderly and Handicapped Pedestrians,"[5] investigated the problems the elderly face as pedestrians. Typical problems include difficulty with curbs or steps, uneven walking surfaces, directional signs, street crossings, and traffic signals. Testing of countermeasure such as widening of sidewalks at intersections, curb ramps, textured guide strips, and midblock crosswalks was conducted. A methodology to create a route or network that is accessible to elderly and to handicapped pedestrians has been developed and is available as a user's manual. Guidelines[7] for making overpasses and underpasses accessible to the elderly have also been developed. Topics covered in the Guidelines included ramp grade and length, rest areas, stairway design, handrails, lighting, and signs.

Finally, FHWA in cooperation with the National Safety Council, is implementing a national emphasis program on pedestrian safety, "Operation Pedsaver." The elderly pedestrian is a primary focus of Operation Pedsaver. This effort will be coordinated with those of other corporate and public interest groups to reduce the number and severity of pedestrian accidents in the United States.

Policy Considerations

Driving and walking are the most significant modes of travel for the elderly in the United States. FHWA´s Offices of Engineering, Highway Safety, and Traffic Operations are working together to develop policies that meet the needs of the elderly on Federal-aid highways. For example, the Office of Engineering has prepared a resource document, "Facilities for Accommodating Physically Handicapped and Elderly Persons in the Federal-Aid Highway Program[8]." This document describes exactly how highway facilities can meet the needs of the elderly, and how these accommodations can be financed. Guidelines for ramp slope and length, parking space layout, tactile surface treatment, signing etc. are included in this document. Other design and operational requirements, funding sources and technical information are also included.

FHWA´s Offices of Highway Safety and Traffic Operations are working to define and scope the problems faced by the elderly driver and elderly pedestrians. This in-house effort includes a literature and state-of-the-practice assessment to identify specific highway related problems for these users and what can be done to address these problems. Based upon this, recommendations for further agency actions will be developed. This effort will be completed within the next year and will offer valuable direction to future policy affecting the elderly.

Technical assistance has also been provided to the American Association of Retired Persons (AARP) in the development of a safety program for elderly pedestrians who are, as a group, three times more likely to be killed in a pedestrian accident than are younger persons. The slide/ tape show will be distributed by AARP through its 5,000 local chapters. The program, entitled "Safety Steps for Pedestrians," will be presented on Wednesday in Session 15C of this Conference.

Discussion

In the past, the elderly have been grouped with the handicapped in research and in policy initiatives. Although there is some overlap of the two groups, each group is being recognized as being different from the other. In addition, the grouping of the elderly is also giving way to the recognition that elderly persons are very diverse and have different requirements according to their specific capabilities. The division of the elderly into the "young-old, medium-old, and old-old" is but one example of how the diversities of the elderly are beginning to be appreciated. Therefore, in determining how highway facilities can be safely and efficiently used by the elderly, careful attention is being directed towards considering the varied needs of the elderly as well as those of the younger population. For example mechanisms for accommodating the novice elderly female driver must be considered, since older women are learning to drive to maintain their independence. Techniques to allow the elderly to continue driving as long as is feasible must also be developed. Transportation for the elderly contributes significantly to their independence. FHWA is striving to make Federal Highways usable by elderly persons to maintain this independence, while insuring the safety and efficiency of the roadways for all users.

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5.0 ERGONOMICS AND ENGINEERING

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Page

Role of Bio-Medical Engineering in Mobility and Transportation

USE OF RELATIONAL DATA-BASE MANAGEMENT SOFTWARE AS A TOOL FOR SPECIALIZED TRANSPORTATION FLEET MAINTENANCE MANAGEMENT

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1. INTRODUCTION

Fleet maintenance management, which includes preventative maintenance, repair scheduling, and vehicle performance analysis, has been a neglected management area for many smaller specialized transportation programs. Reasons for lack of attention to maintenance management include special maintenance needs resulting from the unique operating conditions of specialized providers (e.g. lift usage), lack of adequate personnel to both operate the program and track vehicle performance, and inadequate resources to maintain a sufficient back-up fleet.

These extraordinary demands on specialized fleets and their managers require strategies to improve vehicle performance and longevity without significant increases in demands on agency personnel. One strategy is through management development training to improve skills; another is through improved technology.

On the basis of the outcomes of a vehicle maintenance training program, and through consultation with specialized transportation managers, a need for a low-cost computerized vehicle maintenance management program was identified. PC-ST MAINTENANCE, a specialized transportation vehicle maintenance management program, was developed to help specialized transportation providers track vehicle performance without devoting additional personnel to the task.

2. APPROACH AND METHODOLOGY

2.1 Background

Vehicle maintenance management poses a special problem to specialized transportation and rural transit agencies. Vehicle maintenance was cited as causing the most trouble for rural transit operators in the Section 147 Demonstration Projects, with preventative maintenance being the most overlooked area. [1] While many agencies, with growth and experience, have improved their practices in vehicle maintenance management, many still cite it as a problem which is difficult to manage, particularly in the smaller, newer, and most rural systems.

Lack of attention to maintenance management is a result of many factors including special operating conditions of small rural systems, lack of adequately trained personnel, and inadequate financial resources to properly maintain the equipment. The special operating conditions of rural agencies include lack of sufficient resources for back-up equipment to allow easily scheduling preventative maintenance procedures; unusually harsh road conditions (gravel or dirt, poorly maintained roads) which contribute to maintenance needs more intense than the norm recommended by manufacturers; and long miles required to service a lower level of ridership.

In a case study of ten rural agencies conducted in 1982, one system's maintenance practices was characterized as "inefficient and costly" maintenance of older vehicles. Another's frequent maintenance problems were identified as being caused by vehicles which "operate long hours on gravel roads." [2]

In addition to the special service characteristics of specialized and rural agencies, systems in most cases have procured vehicles through a statewide bidding process, with the award going to dealers sometimes hundreds of miles away from the eventual location of the vehicle. The lack of accessibility to dealers, especially dealers who supplied the vehicle in the first place, sometimes creates a great deal of difficulty in obtaining adequate warranty coverage. Distance from equipment dealers, combined with the fact that vehicle modifications such as modified bodies, auxiliary air conditioning systems, and wheelchair lifts may all require servicing in different locations by different dealers, creates additional difficulties making a comprehensive preventative maintenance program an even greater imperative to prevent unexpected breakdowns.

Finally, on the basis of experience with systems in the midwest, many specialized and rural systems do not have written procedures for vehicle maintenance, nor do they maintain a comprehensive record- keeping system for vehicle maintenance and repairs. Information related to vehicle performance and problems often relies on a random approach to maintenance of the vehicle. Failure repair is a practice often used by small and specialized transit operators, even though preventative maintenance has been proven to be a more economical and efficient use of equipment resources. [3] Instead of preventative maintenance, however, transit agencies tend to defer maintenance work to defer cost, probably at greater cost to the agency. [4]

2.2 Existing Vehicle Maintenance Resources for Specialized Transit Agencies

Recognizing the need for management development training in vehicle management, a one-day workshop was developed by the KU Transportation Center in 1984, in cooperation with the Kansas Public Transit Association, the Missouri Public Transit

Association, the Kansas Department of Transportation, and the Missouri Highway and Transportation Department. The topic was selected as the result of a training needs survey distributed to providers in Kansas and Missouri in which vehicle maintenance was listed most frequently as a training need. Vehicle maintenance as a training topic was also recommended by Kansas Department of Transportation and Missouri Highway and Transportation Department staff as a result of their contacts with rural and specialized transit providers in their respective states, and their notes indicating a lack of a comprehensive vehicle maintenance management plans.

The workshop was targeted to specialized and rural public transit managers and was intended to provide an overview of the process necessary to set up a preventative maintenance program for vans and small transit vehicles. This one-day workshop was offered seven times in 1984 in locations in Kansas and Missouri to approximately 171 agency representatives, and focused on developing a manual system for preventative maintenance. The agenda for the workshop included (1) Establishing a Preventive Maintenance Program, (2) Repair Considerations, (3) Maintenance Record Keeping, (4) Vehicle and Equipment Warranties, and (5) Inter-Agency Communication (related to vehicle maintenance).

Training materials used for the course were a collection of some of the materials which are currently available, but which do not necessarily target specialized and rural operators. When they do, the materials usually do not provide information in sufficient depth to lead rural transit personnel through complete development. A list of some of the existing materials available is included in Appendix 1.

Response to the workshop was extremely favorable, but pointed out deficits in the current practices of specialized transit fleet maintenance, and the dearth of information available to managers in setting up a comprehensive maintenance management system. Several participants related incidences in which no written policies on vehicle maintenance programs existed in their agencies; in several cases, these individuals had become employed months or years after purchase of vehicles and found no history on preventative or repair activities on the vehicles. Many participants indicated that they came into their positions without knowledge of or prior experience with establishing an equipment maintenance program.

2.3 Rationale for Development of Comprehensive Maintenance Management Package for Specialized Transportation

While there are no data available on the costs to specialized transportation agencies resulting from a lack of clearly established maintenance practices, it is certain that lack of adequate maintenance contributes to substantially reduced vehicle performance and vehicle life; and, in some cases, increased operations costs (e.g., higher fuel costs, higher

insurance costs). While many programs report that vehicles are falling apart with 60,000 to 80,000 miles, other operators have vehicles with more than 200,000 miles.

As an example, the difference in a $25,000 vehicle performing adequately for a transit agency for five years rather than four years results in an annual average savings of approximately $1,250 (i.e., annual prorated cost for five years is $25,000/5=$5,000, for four years is $25,000/4=$6,250, a difference of $1,250). An even greater savings may be realized when taking into consideration lower insurance costs, improved fuel efficiency, and fewer catastrophic failures resulting from a good vehicle maintenance program.

To be sure, some of these differences in vehicle life and performance among properties may be attributed to factors other than vehicle maintenance; e.g. differences in road conditions or differences in quality of vehicles among providers. However, there is historical evidence that points to maintenance practices as a major contributor to differences in vehicle performance. In addition, during the course of the Kansas and Missouri workshops, informal surveys were taken on number of miles on vehicles and vehicle condition. It was generally the systems who had developed the more comprehensive maintenance procedures that reported vehicles with very high mileages.

No materials currently exist which provide the appropriate level of assistance to small rural transit operators; consequently, they are often faced with utilizing a trial-and-error method of developing a vehicle maintenance system. Much of the expertise in the area is available only through verbal "best practice" recommendations from those managers who have been involved in specialized or rural transit management for a number of years.

2.4 Rationale for Software Development for Specialized Transportation Maintenance

Microcomputer technology has advanced to the point that in the very near future the greatest majority of small transit systems will be able to afford microcomputers; many already have them. Vehicle maintenance is particularly problematic in specialized transportation, and is particularly amenable to data-based management systems solutions. [5] However, most small systems will not be able to purchase commercial vehicle maintenance software packages currently available, ranging in price from $1,000 to $6,000+, nor pay extensive technical support to write a program for their agency.

Microcomputer equipment is well suited to the needs of specialized transportation agencies. The increased management information that can be provided to the transit manager is valuable to the operating efficiency of the agency, and can be provided without intensive labor usually not available to the

rural transit manager. However, a software system that is overly complicated or extremely expensive will not serve the needs of any but the "wealthiest" of agencies. A public domain software package specially designed for specialized transit systems, and based on a good foundation of manual procedures, would offset these problems and make the technology commonly available to all operators.

3. PROJECT METHODOLOGY

3.1 General Approach

The general approach to this project was to develop a vehicle maintenance management program which could be used by non-technical personnel in specialized or small transit agencies with a variety of needs; and operating with either in-house maintenance or contracted maintenance. The program was to be easy to use, used on either on a hard-disk system or dual-floppy system, and adaptable to a variety of types and numbers of vehicles.

3.2 Input from the Field

Interviews were conducted with a number of specialized and small transit associations to establish priorities for items to be included in a computer-based vehicle maintenance package. Key features mentioned in the interviews were that the package (1) should be easy to use for non-technical personnel, (2) should not require extensive daily time to enter data, and (3) easily produces vehicle summary reports at the end of the month, quarter, and year. These features were taken into consideration in the development of the software package.

3.3 Software Selection

The general criteria for selection of the software package included a need for compatibility on all MS-DOS type machines, acceptable processing speed, and ease in modification of the finished product to meet the needs of a variety of agencies. While a programming language like Turbo Pascaltm would meet the criterion of speed and machine compatibility, the program would not be as easy for agency personnel to modify in the field to meet specific applications needs. [Note 1] It was determined that a relational database manager with a built-in programming language would meet all of the specifications desired.

The package design would require significant programming power, and flexibility for modification if desired. At the time the decision was made, two products were determined to meet these criterion well: dBase III and R:Base 5000. [Notes 2 and 3] Because other public domain packages were being developed with dBase (e.g., SST written in dBase II by Transportation Systems

Center), and it was expected that users of SST might develop some technical knowledge in the use of dBase, dBase III was selected as the appropriate choice for this program.

DBase III has a very powerful built-in programming language, and provides a great deal of flexibility in the type of output it produces. It also allows for flexibility in adding or deleting fields, and in modifying the contents of fields. While the programming language is not necessarily simple to use, "menus" can be developed in dBase as the interface with the user, allowing the non-technical user to operate the program with a few basic instructions.

3.4 Program Development Process

A focus in the development of this program was is to build a package which utilizes research and experience already available. There are considerable written materials available in urban transit; however, these materials generally are not suitable to specialized transit operators since the basic assumptions are so different; i.e. the maintenance function of large urban properties are usually totally in-house functions, where rural and many specialized transportation agencies' functions usually have limited maintenance capability or contract out totally. Budgets in large urban systems are much larger to allow for greater economy of scale, and there is generally more flexibility in the use of back-up vehicles.

Manual maintenance procedures in operation in some agencies were reviewed to provide insight into development of a more universally-applicable package. Information collected included how to design a vehicle maintenance management system, descriptions of data collection procedures, sample forms, and procedures for summary reports.

The following provides a list of considerations included in design of the software package:

1. Identification of agency maintenance capabilities and implications for maintenance system design (e.g., in-house, some contract work, all contracted;

2. selection of maintenance approach based on agency needs (e.g. preventative vs. failure repair);

3. establishment of the structure of an Vehicle Maintenance Management System;

4. implementation of data collection procedures for the Vehicle Maintenance Management system;

5. coordination of the maintenance function with other agency functions:

- Communications systems among drivers, dispatchers, and maintenance personnel,
- vehicle scheduling,
- evaluation and selection of new equipment,
- selection and training of personnel;

6. reporting vehicle performance based on maintenance and repair record.

The next step was to develop the software package on the basis of the identified information needs. The basic assumptions underlying the package would be to optimize flexibility of the system, to allow for easily-implemented modifications, to maximize error-checking features of the system, and to make the program available to users without prerequisite purchase of operations software. Because of its widespread use nationally, the MS-DOS operating system would be used as the basis for program development.

At a minimum, it was determined that the software program would have components of (1) Vehicle Histories, (2) Daily Performance Records, (3) Preventive Maintenance Schedules, and (4) Summary Reports (Consumables Report, Vehicle Performance Summary, Fleet Performance Summary, Vehicle Condition Report, Vehicle Repair Record). The package needed to allow users to select either time-based or mileage-based maintenance scheduling (e.g., monthly schedule or every 3,000 miles), and would be able to change interval parameters, as desired.

4. RESULTS

4.1 Description of the Program

A public domain software package for specialized and rural transit maintenance management was developed which is flexible and easily modified to fit the needs of a wide variety of transportation systems. The program is based on a series of small databases which are linked together through common fields (a feature of relational databases). The primary field through which most of the databases are linked are through the vehicle identification number. The program has made for provision for the agency to assign three-digit identification codes to their vehicles, rather than using the factor identification. However, the vehicle history database provides the opportunity to identify the factory identification number and pair that with an agency identification. In that way, if there is ever any question related to vehicle identification in reporting, the program provides the paired identification numbers.

Another field on which databases are linked are the dealer's identification number for vehicle purchase or repair of specific equipment on the vehicles, such as auxiliary air conditioners, lifts, ramps, or radios. This allows for easy identification of vendors for specific warranty work or other repairs on a vehicle.

One of the databases included in the program is for basic descriptive history of the vehicle: year, make, model, capacity, dealer identification, purchase date, mileage at purchase, and special equipment. Exhibit 1 provides a listing of the database used for vehicle histories.

EXHIBIT 1

VEHICLE HISTORIES DATABASE

```
Structure for database : A:vehicle.dbf
Number of data records :      63
Date of last update    : 06/24/86
Field  Field name  Type       Width    Dec
    1  VID         Character      4
    2  VEHID       Character     23
    3  YEAR        Character      2
    4  MAKE        Character     12
    5  MODEL       Character     12
    6  STYLE       Character     20
    7  WHEELCAP    Numeric        2
    8  NONWCCAP    Numeric        2
    9  PRCHDATE    Date           8
   10  PRCHMILE    Numeric        6
   11  DEALID      Character      4
   12  COLOR       Character      9
   13  AUTOTRAN    Logical        1
   14  AC          Logical        1
   15  LIFT        Logical        1
   16  RAMP        Logical        1
Press any key to continue...
   17  RADIO       Logical        1
** Total **                     110
```

a. PC-ST MAINTENANCE Modules

The program is menu-driven to which additional modules may be added. Accessing any item on the menu requires only that the first letter of the item choice be pressed (marked in parentheses). Pressing the single key takes the user to another sub-menu from which to choose additional selections.

Currently the modules include "Vehicle Histories," "Monthly Vehicle Operations" update, "Preventative Maintenance Schedules," "Repair Records," "Vehicle Performance Reports," and "Program Installation." Exhibit 2 provides an illustration of the opening menu on the program.

EXHIBIT 2

OPENING MENU OF PC-ST MAINTENANCE

PARATRANSIT VEHICLE MAINTENANCE PROGRAM *** MAIN MENU ***

(H)istory of Vehicles

(M)onthly Vehicle Operations Updates

(P)reventative Maintenance Schedules

(R)epair Records

(V)ehicle Performance Reports

(I)nstall Program

<Return> to System

Type the letter corresponding to the function you want.

DBase III requires two disks for operation. The first is inserted to start the program (system disk), the second disk replaces the first with the actual database program once the system has "booted." Since users might want to use the program on a hard-disk system, a dual-floppy system, or a hard disk plus

floppy, it was necessary to design the program to allow the user to assign drive locations for program files and data files.

A user with a dual-floppy system will generally want to place the program files on the same disk with the second DBase III disk, and the data files on a data diskette on drive B. A user with a hard disk system probably will want the entire program on the hard disk, or possibly the DBase III program and program files on the hard disk and the data files on the single floppy (e.g., C: and A:). The installation module in PC-ST MAINTENANCE provides that option to users. Other options provided to the user with the installation program includes preparing a data disk for a month or a year (depending on system needs). Exhibit 3 provides an illustration of the installation module menu.

EXHIBIT 3

INSTALLATION MODULE

PARATRANSIT VEHICLE MAINTENANCE PROGRAM   MAINTENANCE PROGRAM UTILITIES

(S)et up disk drive specifications

(M)onthly Program Setup

(Y)early Program Setup

(Q)uit to Main Menu

Type the letter corresponding to the function you want.

Users entering information are provided with a data entry screen, providing them with prompts for information to include. Exhibit 4 provides a sample data entry screen produced by the program for the user.

EXHIBIT 4

DATA ENTRY SCREEN FOR PC-ST MAINTENANCE

PARATRANSIT VEHICLE MAINTENANCE PROGRAM ***VEHICLE HISTORIES***

Agency Veh. Id: [ ] PURCHASE DATE: [/ / SELLER'S ID: [ ]

VEH. ID NUMBER: [VEH YEAR: [ ]

VEH. MAKE: [ ] VEH. MODEL: [ ]

VEH. COLOR: [ ] VEH. BODY TYPE: [ ]

MILES AT PURCH: [0] VEH. CAPACITY (WC): [0]
VEH. CAPACITY (NON-WC): [0]

AUTOMATIC TRANSMISSION? (Y/N): [ ]AIR CONDITIONING? (Y/N): [ ]
WHEELCHAIR LIFT? (Y/N) : [ ]WHEELCHAIR RAMP? (Y/N) : [ ]
2-WAY OR CB RADIO? (Y/N) : [ ]

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b. Interface with Other Software

PC-ST MAINTENANCE was designed to interface with a specialized transportation performance monitoring system already developed in DBase III, and could be run in conjunction with any other menu-driven DBase program developed. The program under which the vehicle maintenance module was developed collects daily information on rider identification, date of ride, funding source, and trip purpose, and then is able to generate monthly performance summary reports, budgets, monthly financial summary reports, and monthly billings for service contracts. PC-ST MAINTENANCE then becomes another module added to the main program which can be accessed by the specialized transportation manager. However, the two programs combined are too large to run on a dual-floppy system, and can only be accommodated with the use of a hard-disk system. Therefore, a stand-alone version was developed for those without access to a hard-disk.

In addition to specially-developed DBase III programs, DBase is able to easily produce data files that can be read by Lotus 123 (Version 2)tm or Supercalc 3tm to produce spreadsheet output and graphs available through those programs. [Notes 4 and 5] DBase also can generate output to any word processor able to read ASCII format. Using a word processor, professional monthly summary tables can be output into annual reports or other documents.

4.2 Program Output

There are three summary reports currently produced by PC-ST MAINTENANCE (although, because of the module design, others can be added as needed by agencies). The first is a vehicle inventory, the second a vehicle performance summary, and the third a preventative maintenance schedule.

a. Vehicle Inventory

The first is a vehicle inventory record of the agency's fleet. Information included in the inventory includes descriptive information (year, make, model, identification number, capacity, special equipment, mileage, and condition. Condition is a subjective measure, measured from 1 (poor) to 5 (excellent).

b. Vehicle Performance Summaries

The Monthly Vehicle Performance Summary includes information on each vehicles such as number of miles driven, total fuel used, oil added, preventative maintenance cost for the month and year-to-date, repair costs for the month and year-to-date, average miles per gallon, and maintenance cost per mile.

c. Repair Records

The repair record is an incident summary for each vehicle repair completed. Information included in the repair record includes vehicle identification number, date of repair, vendor providing repair, description of work done, parts list and cost, and labor cost. The repair incident report provides a print-out of repair incidents for one or all vehicles during a given time period.

d. Preventative Maintenance Schedule

The Preventative Maintenance Schedule provides the user with options to set up the maintenance schedule for each vehicle, either by time or mileage. Items included on the preventative maintenance schedule include oil change and filter, lubrication, spark plugs, filters, points, compression check, PCV valve, brake inspection, reline brakes, belts, hoses, and clamps, brake fluid, transmission fluid, power steering fluid, battery maintenance,

cooling system, lift maintenance, air conditioning gas and maintenance. Once this schedule is established, each run of the preventative maintenance schedule will produce a checklist for the vehicles that will require maintenance during the coming month, based on the average anticipated monthly mileage for that vehicle.

4.3 Requirements for Operations

PC-ST MAINTENANCE requires a MS-DOS based microcomputer with at least 256K of internal memory, and either a hard-disk storage system or a dual-floppy system. The program currently requires the dBase III program on which to run. However, once the program is ready for distribution, a compiled version will be produced no longer requiring dBase to run the program.

5. CONCLUSION

5.1 General Description

PC-ST MAINTENANCE provides assistance with maintaining a vehicle maintenance management system, and is designed to integrate with other DBase III-based reporting systems. The program is primarily for use by non-technical users in specialized or small rural agencies. While it can be used for any system with one vehicle or more, it primary value will be to agencies with five to twenty-five vehicles. Less than five vehicles can be fairly easily tracked in a manual system; more than twenty-five will need a vehicle maintenance program that is more sophisticated than PC-ST MAINTENANCE, and commercial packages costing $1,000 to $6,000 and up, when prorated per vehicle, become more affordable.

5.2 Debugging and Testing

There are several components of the vehicle maintenance program not yet fully debugged and tested. The Repair and Maintenance Summaries are still under development, and will require testing to determine appropriate formats to allow for the most universal application for specialized transportation agencies.

Another area still requiring additional development is refining the process for automatically flagging dates for preventative maintenance schedules. The development planned calls for calculating projected intervals based on miles reported each month. Therefore, if the preventative maintenance schedule selected is on a 4,000 mile interval, and the average mileage per month has been 2,000, the program will calculate an approximate date for the maintenance schedule (in this case, every two months.

Once debugging and testing is completed, a compiled version will be developed using a DBase III compiler. Producing a

compiled version will allow users to operate the program legally without a copy of DBase.

5.3 Benefits

It is anticipated that availability of the software-based vehicle maintenance management package to specialized and rural transit operators will improve vehicle maintenance practices, especially for those providers who are new or who lack experience in establishing a vehicle maintenance management program. The software, with the corresponding data collection requirements, is expected to greatly improve the capacity of a small agency to respond to maintenance needs. For systems with no systematic approach to maintenance, these improved practices could result in significant savings in capital investment, operations cost, and potential liability loss.

NOTES

Note 1: Turbo Pascal a product of Borland International.

Note 2: DBase III a product of Ashton-Tate.

Note 3: RBase:5000 a product of Microrim.

Note 4: Lotus 123 a product of Lotus Development Corporation.

Note 5: Supercalc 3 a product of Sorcim.

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[4] Etschmaier, Maximilian M. and Anagnostopoulos, George. Systems Approach to Transit Bus Maintenance. Transportation Research Record #994, Recent Advances in Bus Transit Operations Planning, 1984.

[5] Couture, Michael R. and Paules, Granville E. Improved Decision-Making Power for the Transit Maintenance Manager. Prepared for Presentation at the 1984 Transportation Research Board Annual Meeting, Washington, D.C.

[6] Etschmaier, Maximilian M. Transit Bus Maintenance Management in the United States. Transportation Research A, Volume 19A, No. 1, 1985. pp 1-14. Several of the items included in the tentative outline are suggested in this paper as critical components of transit maintenance management.

COMPUTERIZED SCHEDULING/BROKERAGE DEMONSTRATION PROJECT IN VANCOUVER

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ABSTRACT

In March 1985, in order to foster the development of technology to improve transportation services for elderly and handicapped persons, the Transportation Development Centre of Transport Canada and British Columbia Transit initiated a jointly-sponsored, eighteen-month, scheduling/brokerage demonstration project in Vancouver.

The demonstration project has been under the overall direction of a Steering Committee composed of representatives from the Transportation Development Centre, the Canadian Urban Transit Association and several Provincial Transportation Ministry's. A Users Advisory Committee, as well as the operators, were involved in helping to design and implement the computer systems.

The specific objective of the demonstration project was to improve the quality and cost-effectiveness of transit services for the disabled through the selection, implementation and demonstration of computerized scheduling/brokerage systems in Vancouver, with particular emphasis on the best application of microcomputer technology to the personalized form of transportation offered by special services.

One of the applications being sponsored utilizes low-cost graphical display technology to improve the scheduling/dispatching function in shared-ride transportation environments. Operating on a local area network, the system provides a graphical display of available services and current demands as a scheduling/dispatching aid for operators. The other application being sponsored is a computer software package for microcomputers that provides assistance in the client registration, trip reservation and management information function of special services. This application is being upgraded to provide scheduling assistance through a tabular display of schedules for the operator. It will also operate on a multi-user microcomputer configuration.

The end products of the demonstration project include: several computer software packages for special transit service operators, including user manuals and tutorial programs; a series of reports on computer-aided scheduling of special transit services; a report on the overall demonstration project; and, an audio-visual presentation on the results of the demonstration project.

An overview of the demonstration project, focusing on a description of the two microcomputer applications, is provided in this paper. The project is scheduled for completion at the end of September 1986, but the applications setting, project organization, project approach, and initial results are described in this paper.

Special Transit Services in Canada

Special transit services are generally demand-responsive transit services provided for individuals with disabilities sufficiently severe that they are physically unable, without assistance, to use conventional public transit with dignity. They are a parallel door-to-door transit service that is scheduled on a request basis for eligible users who telephone for service. Vans or small buses outfitted with wheelchair lifts are generally used. Lately, however, the use of taxis has been finding favour in Canada as a means of providing a supplementary and complementary service.

Private rehabilitation and charitable organizations were among the first to introduce special transit services for transporting disabled persons whose mobility was reduced. Because they were highly adaptable to time, space and quality requirements, special transit services were an obvious solution to the problem and thus were long regarded as an excellent means of solving the transportation problems of disabled persons. These services were characterized by: charitable or social service funding, volunteer labour, high fares, and a targeted clientele.

Most urban communities in Canada have special transit services. In fact, even smaller communities, without conventional transit services, often have some service for the elderly and handicapped. Many provincial funding programs to support these services were implemented in 1979. It is now estimated that more than $60 million is spent annually in Canada providing door-to-door special (or custom) transit service for disabled people in about 330 cities. Each trip costs an average of $13 to provide, with productivity typically just over two rides per hour (1).

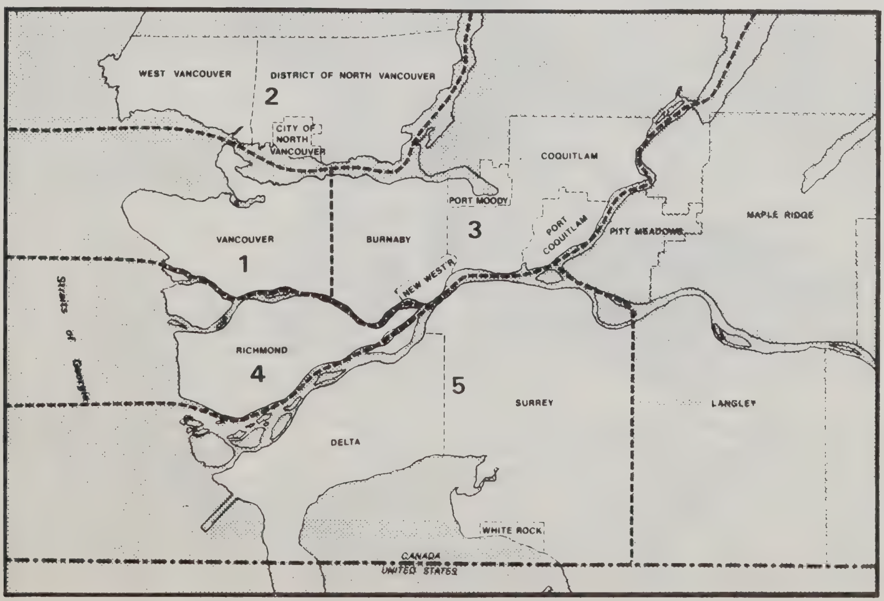
Special Transit Services in Vancouver

BC Transit, the provincial funding agency responsible for all transit services in the Province, introduced the Custom Transit Services Program in April 1980. Prior to the introduction of this program, transportation services for handicapped persons were provided by various charitable and community organizations as a supplemental service to their other social service operations. Funding was provided by charitable donations and the Provincial Ministry of Human Resources.

As a result of the introduction of the Provincial Program, the Vancouver Region was divided into eight service areas along municipal boundaries, with a total of nine operating companies providing service within the region. All identifiable, existing, provincially-funded transportation services for handicapped persons were incorporated into the Program. The Program provides a policy, funding and administrative framework for the provision of custom transit services in the Province. BC Transit contracts with private companies or nonprofit societies to operate the service, supplies the vehicles and equipment, assists in administration, and is responsible for service specification, funding, planning, marketing, monitoring and evaluation activities.

Subsequent efforts to reduce system administrative costs and improve service efficiency and cost-effectiveness resulted in a reduction in the number of operating companies from nine to eight in 1983 and from eight to seven in 1986 and the number of zones has been reduced from eight to five since 1980. The five service zones as of July 1986 in the Vancouver Region, as illustrated in Exhibit 1, and the operating companies serving each zone are: (1) Zone 1: Pacific Transit Cooperative, (2) Zone 2: HandyDart North Shore, (3) Zone 3: Western Society for Senior Citizens (with Royal City Taxi Supplement), (4) Zone 4: Richmond Volunteer Transportation Society, (5) Zone 5: Deltassist Society, Surrey Community Resource Centre Society and White Rock Community Aid Society.

Exhibit 1: Custom Transit Service Zones

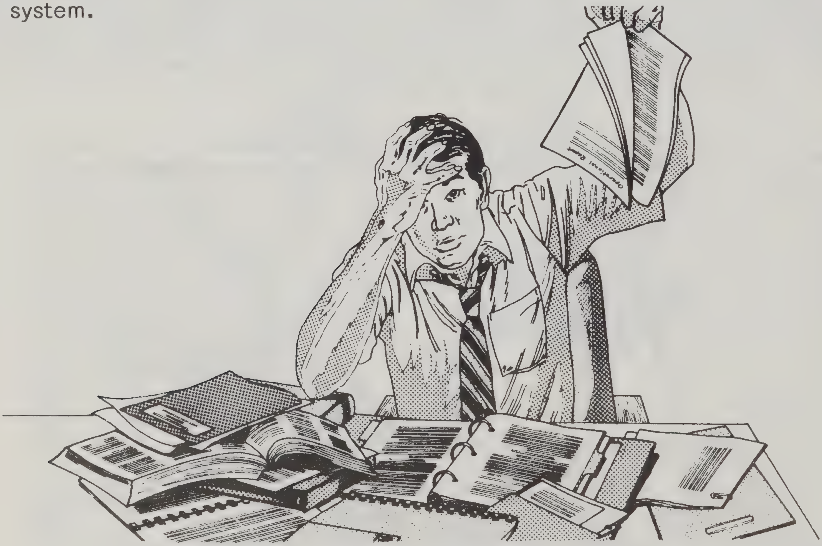


The delivery of service in the Custom Transit Program is the responsibility of the seven operators. These locally-based operators provide a very personal and, in many cases, a cost-effective service for the clientele in their respective communities. However, they operate in distinct geographical zones within the region, and opportunities for improving the efficiency of trips delivered across several zones have not been fully explored.

An analysis of the custom transit operations indicates some concerns, such as a high percentage of deadhead time and a high percentage of trips that take place with only one passenger on the vehicle (2). This analysis indicates a need to look more closely at opportunities for improvements (3) in the way that the service is managed and at the internal processes and information flows (especially in the reservation, scheduling and dispatching tasks) that are used by the individual custom transit operating companies in operating, controlling and monitoring the service that is offered to their clientele.

Management of Special Services

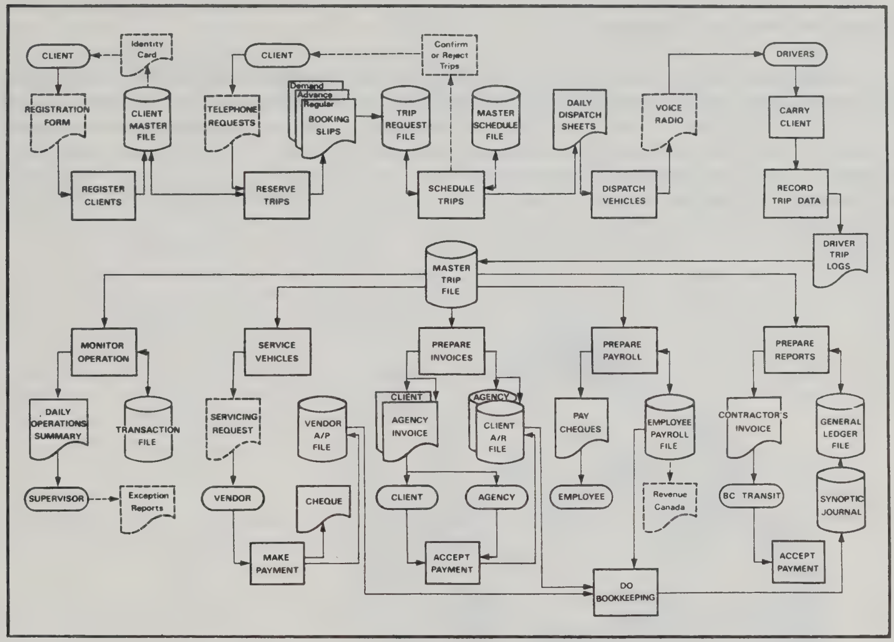
Custom transit services, by their very nature, are extremely management and labour-intensive. Improvements in productivity and efficiency rely heavily on improvements in operations management -- which is usually performed manually. Much of the operations management effort is concerned with recording, retrieving, exchanging and displaying information. The manner in which information flows are dealt with determines to a large extent the efficiency of the operation, the quality of the decision-making, and the level of service that can be offered to the users of the system.



Improvements and expansion of transit services for the disabled are often limited, not by demand (which is usually greater than the supply), but by the efficiency of operations. In fact, these services tend to rely fairly heavily on management and control of the demand by means of eligibility criteria, ride prioritization or other service constraints. Effective control of demand with corresponding improvements in service quality requires better time responsiveness in the manner in which information flows are dealt with.

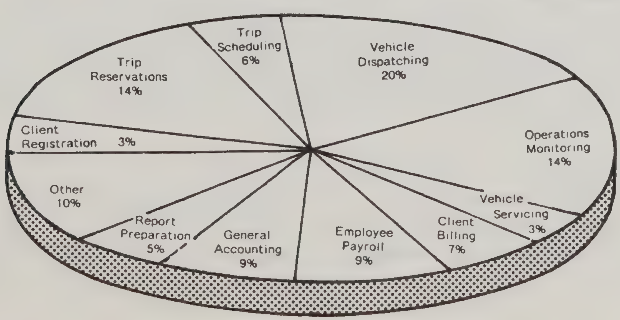
The information flows in a typical custom transit office are illustrated in Exhibit 2. As can be seen, the office is extremely transaction and information-oriented, mainly as a result of the information demands inherent in the type of service provided.

Exhibit 2: Information Flows in the Custom Transit Office



The time spent in the typical custom transit office on the various tasks is illustrated in Exhibit 3. Because of the large amount of time spent on purely administrative chores, there does not seem to be nearly enough time spent on analytical tasks, such as trip scheduling. And it would normally be the application of custom transit office staff on these analytical tasks, such as fine-tuning the schedules, where the greatest benefits in the overall operation would be achieved.

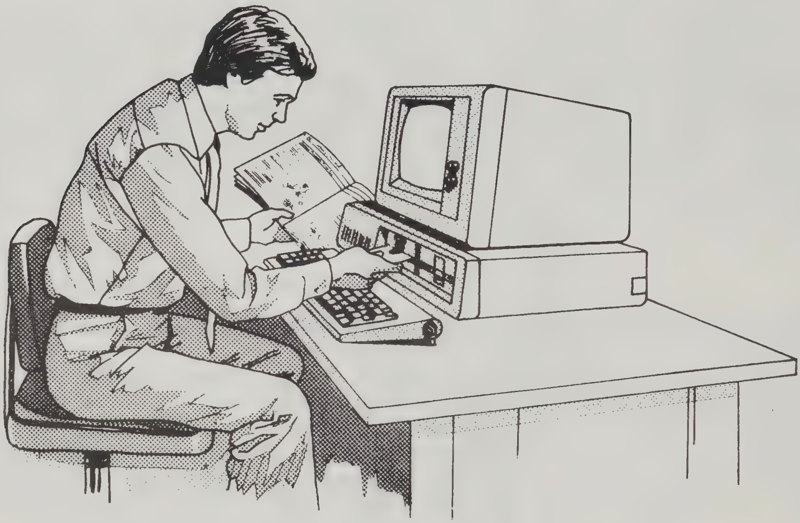
Exhibit 3: Distribution of Time Spent on Office Tasks



In addition to the lack of time spent on analytical work, it is fairly obvious that too much time is spent on less-than-productive work, mainly as a result of the awkwardness and imprecision of the information handling and communication processes that are used when manually manipulating and processing large quantities of information.

Opportunities for Improvement

It is fairly clear that the computer can have an enormous impact on both the quality and speed of information flows within the management and operation of a custom transit office. In Victoria, considerable work has been undertaken in developing the role of the computer for performing information storage and transmission tasks (recording reservations and cancellations; displaying information to call-takers, dispatchers and schedulers), as well as in the generation of system statistics from this stored information.



Computer assistance should enable the custom transit office to attain the following objectives: the elimination of redundant and unnecessary tasks such as copying of information; better utilization of human resources of tasks that require judgment, initiative and analysis; faster, better decision-making; and better exploitation of the unique capabilities of custom transit office workers.

The extent to which the computer can aid in the decision-making process involved in scheduling is a more complicated issue. But it is in this area where the greatest benefits are anticipated. Matching the supply of available vehicles with the demand for trips, and making the most effective use of limited resources, is the challenge faced daily by managers of special transit services.

APPLICATION OF COMPUTERS

To provide some answers to these questions, a feasibility analysis was undertaken in September 1984 (4). The primary purpose of the investigations was to determine a plan of action for BC Transit with respect to the application of computerized reservation/scheduling/dispatching systems to custom transit operations in the Vancouver Region.

The general approach in determining a plan of action was to undertake a cost-effectiveness analysis of alternative computer systems and configurations and, in so doing, to determine the operational and economic feasibility of computer assistance in custom transit operations.

Alternative Functional Applications

In any investigation of computer applications in custom transit operations, the degree of application is certainly a consideration. The computer can be used to provide an aid to the decision-maker by displaying the information necessary to assist in the decision process (computer-aided system), or it can function with little or no human decision-making (computerized system). Computer assistance can be applied to the management information task, the client registration and trip reservation task, the scheduling task (through the use of algorithms, heuristic techniques, or graphical aids), or the dispatching task.

Quite often, alternatives are categorized by this degree of application to the major functions: (1) computer-aided information system, (2) computer-aided reservation, (3) computer-aided scheduling (4) computer-aided communications and dispatching, and (5) computerized scheduling system.

These alternatives are typically hierarchically-inclusive (e.g. a computer-aided reservation system will include a computer-aided information system) although exceptions exist (e.g. computerization of the scheduling task does not depend on the use of computer-aided communications).

All of the first three alternatives assume a continuation of the current common communications system, consisting of person-to-person telephone conversations for all interaction between clients and the custom transit office, and voice radio communications between the dispatcher and the drivers. The former can be, at least partially, replaced by computerized message recording and call-backs, while the latter can be partially replaced by digital communications.

A central issue in the consideration of these options is the treatment of the scheduling task. Implicit in the undertaking of most computer applications are certain expectations that computer assistance in the scheduling task will result in increased productivities -- that computer application solely on the administrative side of custom transit will offer insufficient benefits to justify the expenditures required.

Alternative Operational Configurations

Another basic consideration is the operational configuration. This depends largely on the type of operation. In Vancouver, several alternatives, categorized by their basic operational configuration, were investigated: (1) a Decentralized

System, in which a microcomputer is provided to each independent operator, (2) a Coordinated System using a central minicomputer and remote terminals for each independent operator, and (3) a Centralized System in which one operating company uses a minicomputer and provides services throughout the Region.

The alternatives are not necessarily mutually-exclusive. For example, the decentralized option could closely approximate the coordinated alternative by using multi-user or local area networked microcomputers communicating with each other through a host mainframe computer. Similarly, the coordinated option could closely approximate the centralized option by replacing the remote terminals with printers that would just print out vehicle schedules for the operating companies.

There are a number of functions that benefit from centralization in any custom transit service -- for example, marketing, planning, funding (the 'brokerage concept'). By categorizing the alternatives according to the configuration of the computer system, it will be possible to analyze the question of computer assistance being one of these functions. And, if it is, the degree of centralization desired.

Results of the Feasibility Analysis

Based on the analysis undertaken and the information received from various system suppliers, it was concluded that the application of computers to custom transit operations in the Vancouver Region was feasible from a technical, operational and economic point of view.

It was concluded that the most feasible option was one in which a microcomputer system would be provided to each independent operator -- the decentralized alternative. It was also concluded from the analysis of the coordinated option that additional benefits can be achieved by investing in equipment to facilitate communications between the separate microcomputer-based systems.

A final conclusion was that the decentralized system should be implemented in stages (in terms of both number of functions and number of installations) with adequate testing and demonstration before preceding to the next stage.

Based on the conclusions resulting from the feasibility analysis, BC Transit decided to begin implementation of computer-aided scheduling systems in the Vancouver Region and, because of the potential transferability of experience offered by the microcomputer-based approach to other cities in Canada, requested Transport Canada to participate in a demonstration project.

THE DEMONSTRATION PROJECT

One of Transport Canada's research and development programs is a program designed to encourage transportation operators to take advantage of new methods and technology to assist disabled Canadians. In March 1985, in order to foster the development of technology to improve transportation services for elderly and handicapped persons, the Transportation Development Centre of Transport Canada and British Columbia Transit initiated a jointly-sponsored, eighteen-month, scheduling/brokerage demonstration project in Vancouver.

Transport Canada and BC Transit initiated this demonstration project to explore the application of microcomputers to custom transit to improve the operating efficiency and effectiveness of custom transit and to help managers better match supply and demand. The project began in April 1985 and concludes in the Fall of 1986. The setting Is Vancouver, British Columbia, host city of Expo 86 from May through October.

The specific objective of the demonstration project is to improve the quality and cost-effectiveness of transit services for the disabled through the selection, implementation and demonstration of computerized scheduling/brokerage systems in Vancouver, with particular emphasis on the best application of microcomputer technology to the personalized form of transportation offered by special services.

Project Approach and Methodology

The overall approach taken for the project was one of incremental improvements to proven, operational, modular systems in order to develop a generic computerized scheduling/ brokerage system with minimum risk and maximum cost-effectiveness. It was proposed that the resulting generic computerized scheduling/ brokerage system would promote optimum service delivery and the matching of supply with demand by establishing procedures for exchanging information between clients and operators through an intermediary coordinating computer network.

The general project methodology included the sequencing of activities and decisions leading to the definition, development, and implementation of several computerized scheduling systems for custom transit services.

A cyclical, iterative process was used to tailor the computer systems in relation to the requirements, constraints and capabilities of the transit operators.

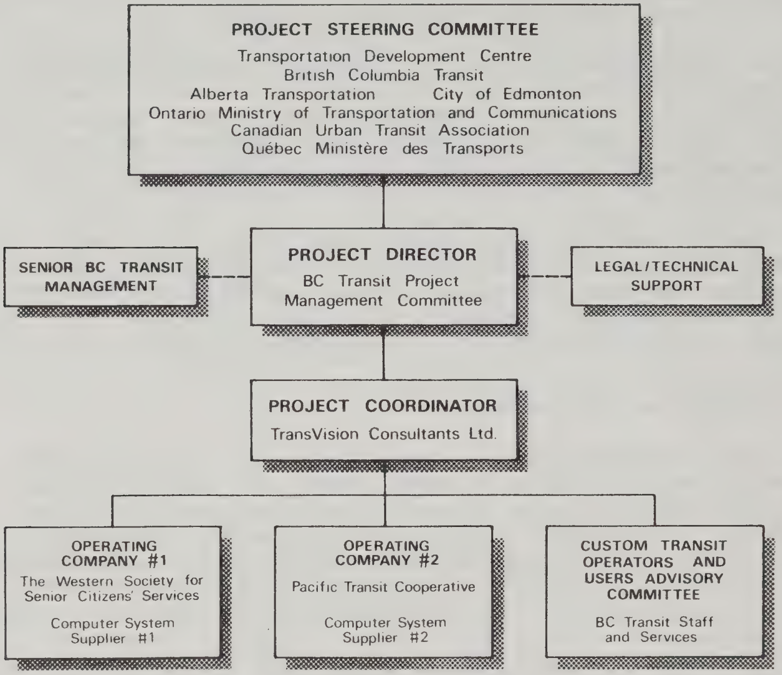
The overall approach was divided into four phases:

- **Phase 1: Analysis** - review, analysis and documentation of existing computer applications in special transit services for the disabled in Canada (5), including comprehensive documentation of the existing Victoria system.
- **Phase 2: Definition** - definition of user and functional requirements, investigation of operational systems, solicitation of proposals and selection of systems.
- **Phase 3: Development** - development, installation, testing and evaluation of two different computerized or computer-aided scheduling systems in Vancouver.
- **Phase 4: Implementation** - implementation and expansion of the proven system to the whole Vancouver area and the documentation of the final results of the demonstration project.

Project Organization

The overall project organization, consisting of a Steering Committee, BCT Management Committee, Users Advisory Committee, Project Coordinator and other support and operating staff, is illustrated in Exhibit 4.

Exhibit 4: Project Organization



The demonstration project has been under the overall direction of a Steering Committee composed of representatives from the Transportation Development Centre, the Canadian Urban Transit Association and several Provincial Transportation Ministry's, including Alberta, Ontario and Quebec.

The BCT Management Committee, comprised of senior BC Transit management staff, has undertaken overall project monitoring, budget and contractual control, and coordination functions for the project.

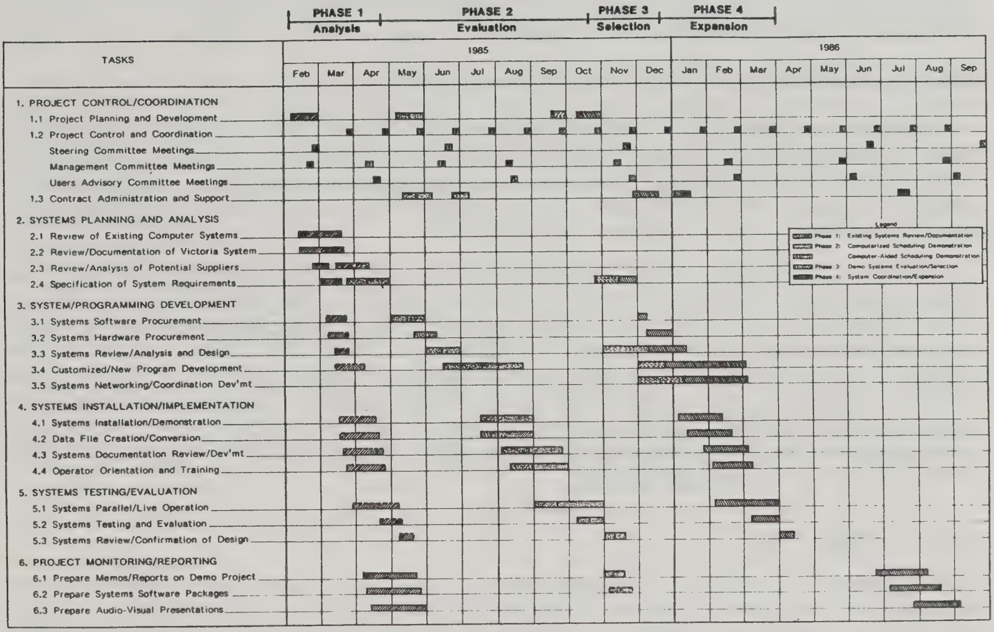
A Users Advisory Committee, as well as the operators, were involved in helping to design and implement the computer systems.

A Project Coordinator was retained by BC Transit to provide detailed project monitoring, control, coordination and reporting for the project. Other services and suppliers were contracted for by BC Transit as required.

Project Schedule and Budget

The project schedule is illustrated in Exhibit 5. The schedule illustrates the cyclical process used to optimize the computer systems in relation to user requirements and system constraints.

Exhibit 5: Project Schedule



The overall project budget is $525,000, of which $300,000 is provided by Transport Canada and $225,000 is provided by BC Transit.

THE COMPUTER SYSTEMS

Two microcomputer software packages were to be tested in daily operation by a custom transit operator serving the central city and Expo 86 site, and a second operator in several suburban municipalities. Later phases of the project are to involve the extension of microcomputers to the remaining operators of special transit in the region. In the regional coordination or brokerage phase, the project will examine the feasibility of an electronic microcomputer network to share trip information between region-wide operators.

The Selection Process

In 1984 and 1985, BC Transit conducted an international search for computerized management and scheduling systems for special transit. First, a Request for Qualifications was issued to twenty-two suppliers in June 1984. Statements of qualification were received from nine suppliers, and a Request for Proposals was issued to seven of these suppliers in April 1985.

In June 1985, under the guidance of the project steering committee, two software packages were selected for demonstration. The selection decision was based primarily on the desire to meet custom transit managers needs and to keep both hardware and software costs affordable for small operators. Although the intention was to test a computerized scheduling system and a computer-aided scheduling system, no computerized scheduling system was able to meet the requirements. Therefore, two different approaches to computer-aided scheduling were selected for the demonstration project. These two systems are described further in the following paragraphs.

DART Manager Plus

BC Transit's Dial-A-Ride Transit Manager (DART Manager) was chosen for use in the New Westminster-Burnaby-Coquitlam suburban area. BC Transit developed this computerized registration, trip reservation, and management information system starting in 1983. A Victoria firm that had experience in the design and development of similar software was contracted to design the custom transit software. BC Transit, in consultation with Dialog Business Computer Systems Limited and the operating company, Accessible Transportation Alternatives Limited, developed the functional specifications.

The system was implemented in the Victoria office in September 1983 on an Onyx multiuser microcomputer with two monitors and keyboards and a dot matrix printer. The Onyx was selected primarily for the multi-user operating system, Oasis, which was available with the Onyx. All programming was done using the Cobol language. The total cost of this two-user system was $19,000 for the hardware and $41,000 for the software (including BC Transit staff time in addition to the software development costs).

The software was the product of a number of sources of information. Many of the concepts and definitions were adapted from other systems. For example, the registration file is similar to that developed for the Ottawa system. Other aspects of the system were adopted from a doctor's scheduling package developed by Dialog. The majority of the specifications for the software, however, were developed by BC Transit and the operating company in conjunction with the consultant to meet the criteria set out for the special transit operation in Victoria.

The initial software development went through three phases. The initial package was implemented in September 1983. It included the primary client registration and trip statistics files. Minor modifications to these programs and the trip statistics programs were added early in 1984. In June 1984, the software package was updated to provide the ability to print trip tickets and mailing labels. As well, the ability to print summary information on clients by zone and disability was added. A major design change which permitted the entry of more than one vehicle number in a trip record was accomplished. Prior to this change, a client travelling five days per week at the same time to and from the same locations but on a different vehicle each day, had to be booked in five different trip records.

As a part of the current demonstration project, this initial software package was converted to the MS-DOS operating system so that it could function on an IBM Personal Computer system. A tutorial program was written by TransVision Consultants using a concurrent authoring system by Evergreen Technologies Limited and the program, tutorial and detailed user manual was packaged for distribution to Canadian operators of transit services for the disabled and their funding agencies for a nominal handling charge.

This package was then selected for installation and testing at one of the custom transit operators in the Vancouver Region. The selected operator has about 2,300 registered users and serves about 330 trips per day with 16 vehicles.

Because the test operator employs 16 vehicles, the software was modified to operate on a multi-user microcomputer system with two or more terminals, using a Xenix operating system. The second version of the software, the DART Manager Plus, also adds some improved reporting and scheduling features, adding full schedule information to the software. Easy keyboard strokes allow managers to check on vehicle status and instantly assign passenger trips.

The software was installed on an IBM PC AT with a 20-Mb hard disk drive, a 1.2-Mb floppy, a streaming tape backup, and an internal memory of 512-Kb. Two Wyse terminals are connected to the computer and the total cost of the hardware, including a TI-850XL dot matrix printer, was about $12,000.

The system was installed in two stages. The multi-user version of the DART Manager was installed in October 1985 and was fully operational in December. In January 1986, a contract was awarded to undertaken the enhancements and the final enhanced system was installed in May with full system operations using the DART Manager Plus beginning in June 1986. Intensive support was provided by BC Transit staff in the initial training and file creation. The operator response to the system has been very encouraging and the implementation has gone very smoothly with the operator taking an active role in the development of the system. The only serious difficulty (the difficulty arose in diagnosing the problem) was a problem with the IBM PC AT hard disk drive which was simply solved by replacing the drive.

Some of the benefits of the DART Manager are more efficient information-handling (greatly reduced paper flow and faster processing of trip requests, with fewer errors), a computerized client registration list that cuts down the time passengers must spend on the telephone requesting service, faster assignment of trips to schedules, and management information summaries that track vehicle and driver performance, and help managers plan schedules more efficiently.

DART Manager Graphics

A colour graphics scheduling system developed by SRI International at the Stanford Research Institute of California for the United States Urban Mass Transportation Administration was selected for testing in the 20-vehicle downtown Vancouver custom transit service.

The heart of this software is an interactive computer-aided graphics display, for vehicle scheduling of both real-time and advance-reservation trips. Like the DART Manager, the DART Manager Graphics handles client registration, passenger reservations and management reporting functions (with the aid of a commercial database management program). The colour graphic display of vehicles and trips overlaid on a city map gives both time and distance information at a glance. By providing immediate visual feedback on the impacts of alternative trip assignments, it helps managers make scheduling decisions.

In 1980, UMTA awarded a contract to SRI International to investigate the feasibility of computer-aided scheduling and dispatching systems for smaller paratransit operations. SRI International analyzed the design of low-cost graphical display technology to aid the process of controlling shared-ride demand-responsive transportation systems. This effort entailed thorough analyses of current paratransit control procedures, including site visits and detailed data collection, statistical analyses of information requirements for control functions and tasks at current operations, design of alternative graphical display configurations, benefit-cost analyses, and recommendations for specific low-cost graphical aids for development, including detailed functional specifications (6).

SRI also developed a prototype computer-aided graphical control system that went beyond the original objectives of the contract. Whereas the major project called for in the contract was a set of recommended specifications for technology development, the actual product was a workable prototype system that embodied the hardware and software technology developed. The prototype system was used to test, verify, and improve the various functional specifications of the graphical-aided technology and was demonstrated to numerous paratransit professionals in the field.

Subsequently a contract was issued to develop hardware specifications, the software and a user manual which was prepared in May 1985. Upon selection of the SRI system by the Demonstration Project Steering Committee in Vancouver in June 1985, a contract was issued to undertake a systems analysis and design to meet the needs of the local operator in Vancouver. This was completed in August 1985. After a period of contract negotiations, a contract was issued on November 6th, 1985. The initial module of the system, client registration, was installed on January 15, 1986. The trip reservation module was installed on February 14th, 1986 and the scheduling module was installed on March 16th, 1986.

At the time, the chosen operator was Pacific Transit Cooperative who operated a 20-vehicle fleet and served around 350 trips per day in Vancouver. Subsequently, as a result of a Vancouver Regional Transit Commission decision to centralize operations within the Vancouver City part of the region, the operation expanded to 50 vehicles and was thus too large for the SRI system. It was therefore relocated to the North Shore Handy-DART service on June 19th. The North Shore Handy-DART service provides about 150 trips per day to 1,000 registered users with 7 vehicles and serves both North and West Vancouver. Preparation of client, address,

vehicle and schedule files took about three weeks and the system was operational by July 7th, 1986.

The DART Manager Graphics has been installed on a local area network, partly because of the desire to compare a local area network configuration to the DART Manager multi-user system and partly because of the extremely flexible configuration provided by local area networks. It was also installed in stages: the client registration module was installed first, then the order taking module and finally the scheduling module. Operator training and support was also provided at each stage of the installation.

The system uses an IBM PC AT Enhanced with 640-Kb and a Priam 60-Mb hard disk drive and tape backup system, and IBM PC XT with 640-Kb and two floppy disk drives. The IBM AT uses the professional graphics controller and display as well as a monochrome display and the IBM XT uses a monochrome display. A Summagraphics Bitpad (electronic tablet) is also connected the IBM AT. The two computers are connected by means of the IBM PC Network hardware and software. The total cost of the hardware, including a dot matrix printer, is about $26,000.

FUTURE PROJECT ACTIVITIES

Evaluation and Expansion

In the summer of 1986, the two systems will be evaluated and software will be extended to operations of the remaining Vancouver-area operators over the following months. A decision will depend on cost (hardware, training, support), system reliability, ease of use, impact on management efficiency and on the quality of service provided to disabled people.

At the same time, an electronic network is to be examined in the brokerage phase of the demonstration project, to improve coordination between the variety of custom transit operators in the region. Work is currently underway to examine the functional requirements and the current status of the technology of such a network. The purpose of this work is to determine the operators' needs and the technologies' capabilities of inter-operator telecommunications and networking facilities.

Project Results

The project is currently about eight weeks behind schedule due to fact that many aspects of the system have developed on the very leading edge of the technology. These aspects include not only the applications software, but the operating systems (Xenix, IBM PC Network) and the hardware (professional graphics controller, electronic tablet, local area network).

The currently-available end products of the project include one report on computer applications in Canadian special transit operations and one software package. Several other reports and software packages will be available to interested transportation agencies in the fall of 1986:

Reports

- The Application of Computers to Special Transit Services. A Review. (TP 6856E, available August 1985).

- The Vancouver Computerized Scheduling/Brokerage Demonstration Project. Executive Summary. (TP 7655E, available late 1986)
- Sommaire administratif - Démonstration d'un système automatisé de régulation et de réservations à Vancouver. (TP 7655F, available late 1986)
- The Vancouver Computerized Scheduling/Brokerage Demonstration Project. Final Evaluation Report. (TP 7657E, available late 1986)

Software

- DART Manager, Version 1.1 (TP 6884E, available 1985)
- DART Manager Plus, Version 1.1 (TP 7658E, available late 1986)
- DART Manager Plus, Version 2.1 (TP 7659E, available late 1986)
- DART Manager Graphics, Version 2.1 (TP 7656E, available late 1986)

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INFORMATION TECHNOLOGY APPLICATIONS IN COMMUNITY TRANSPORT: EVALUATING THE SOCIAL ASPECTS OF COMPUTERISATION IN COMMUNITY TRANSPORT SCHEMES

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Introduction

The information technology in community transport - **IT in CT**- project based at the Department of Transport Technology, Loughborough University, is part of a major government sponsored research programme into information technology applications in transport. The IT in CT study began in April 1985 and the first phase of the research will terminate in September 1987. Additional funding is being sought to continue the project beyond this date.

The project is investigating mini- and micro-computer applications in a selection of dial-a-rides and a community transport/brokerage scheme; in particular the benefits and problems arising from computerisation and the impact of information technology on scheme management and performance. The dial-a-ride schemes included in the study only service elderly and handicapped people whilst the community transport scheme provides minibuses and lift-equipped small passenger vehicles to voluntary community agencies serving a much wider clientele of the transport disadvantaged.

Methodology

The research programme includes undertaking several exercises to collect background information on IT applications in the arena of special transport as well as investigations specific to this particular project. The investigations being conducted are itemised below:

1. A national computer users survey of dial-a-ride and community transport projects has been conducted in collaboration with **Community Transport Magazine**, a trade journal which is subscribed to regularly by more than 600 projects in the U K. The purpose of this survey was to gauge the current uptake of computers in this area of transport operations and to identify those projects where computer applications are more advanced (this latter information will be utilised subsequently to examine the potential for creating regional networks of support for new users of IT).

2. From the onset three projects experimenting with computers were selected for futher investigation. These were Birmingham Ring and Ride, Haringey Dial-a-Ride (a London scheme) and Nottingham Community Transport, which provides a dial-a-ride and community transport/brokerage service. The detailed research in these projects includes direct observation of staff in the use of computer equipment, personal interviews (structured and unstructured) and monitoring of the scheme's transport performance from statistics compiled by the computer. At the beginning of 1986 the Manchester Ring and Ride Scheme was also included in the detailed research programme.

3. The scheme collaborators have joined with the researchers and staff from the National Advisory Unit for Community Transport in forming an IT in CT Development Group, which provides a forum for discussing the results of the research and has also suggested new areas of IT applications, which are being investigated.

The first of these exercises has been largely completed and the other two will continue until the summer of 1987. Preliminary results of the research are presented below.

Analysis

The origins of the study go back to 1984 when the current researchers, Dr David Gillingwater and Dr John Sutton, were examining a range of computer software programs with applications in the special transport services sector. From a literature review of U S experience, 24 software programs were identified as being written for paratransit system management using microcomputers (U S D O T 1984). This can be compared to the situation in the U K, where only one software package is commercially available, although there are two others which have been written as dedicated systems for end-users in the special services sector (Sutton and Gillingwater 1986).

Evaluation of these programs, from a critical literature review and direct experience of four packages (including one selected as 'typical' from the U S A), suggested two major requirements for any computer application in the CT sector. Firstly, a software package dedicated to transport management functions, including at the core of the program a data base management system. Secondly, the ability to use such a package on a microcomputer system, in order to keep the costs at a feasible level within the horizons of voluntary agencies' limited funds.

The choice of management oriented programs is supported by research in the U S A (see, for example, Giangrande and Harman 1982 and Simpson 1982), as opposed to more sophisticated systems incorporating automatic scheduling and dispatching routines,

which are designed for larger transport systems with access to large (i.e. mainframe) computers (see, for example, Wilson et al 1971, Breuer et al 1974, Rebibo 1974, Wren 1981, Strobel 1982, Rousseau 1985). The management software programs are designed as tools to assist in the administration of business systems, such as reducing repetitious paper-work, or to assist decision making by providing up to date data in relevant formats. The scheduling programs,on the other hand, aim to bypass management and dispatchers by automatically allotting vehicles and drivers to particular journeys: this 'expert' function may be relevant in large advanced systems but is considered inappropriate and too overwhelming for most community based transport providers.

The development of a suitable and bespoke management package for dial-a-rides in the U K was undertaken by Fletcher Computer Services at the behest of the National Advisory Unit for Community Transport. This program, called DAR, is the one being used in the four projects under our research evaluation. However, it should be noted that in each project the program has been modified to meet individual needs. As part of the package there is included a general data base management system and other features which enable the end users to develop their own suite of programs or file structures, and incorporate other programs including word processing and accounts software.

These programs have been configurated with two mini-computer systems (Adds Mentor and General Automation) and two micro-computers (IBM PC XT and Olivetti M24). Each runs under the Pick operating system or PC/MS-DOS (converted from Pick using the Picknet program). The total system, hardware and software, is sufficiently varied to provide an experimental base for the research and to evaluate its application in different environments.

Results

Table 1 summarizes the main characteristics of the projects and their system performance. Each scheme has been requested to complete a monthly monitoring sheet: recording information on passengers; vehicle mileage; vehicle utilisation and journey patterns; journey purpose; and various related measures of performance. Statistics from the Haringey scheme have been collected since June 1985 and from January 1986 in the other schemes. Monitoring will continue until December 1986.

The advantage of using a computer is most clearly seen in data processing. Before computerisation the amount of information collected was rudimentary, to say the least, and the minimum necessary to support applications for funding or to produce annual accounts. Most DAR services use manual booking methods which involve considerable paper work, and the booking sheets are either filed away or destroyed after use with little or no analysis of the data collected. The DAR software uses a dynamic

booking system, which means that once data is entered it automatically updates other relevant parts of the system, so that when reports are generated they contain the latest input information.

This feature of the program has proved to be most valuable and allows data to be manipulated in a number of different formats. For example, when a booking is made the origin and destination zones are entered and from this data it is possible to identify major origin and destination zones which can then be used by the transport managers when it comes to deciding upon vehicle allocations. Likewise, data on journey purpose and times of travel can provide a better understanding of the needs of the client group (see Figure 1). The analysis of refusals, cancellations and membership utilisation can give clues toward the amount of needs being met; and when compared with other sources of data, such as the national population census, can provide a picture of where unfulfilled needs are likely to occur. An example of the use of this type of data is illustrated in Map 1 from the London Haringey scheme.

In fact, the use of the computer in data collection has been so successful that the projects have suffered from 'information overload', whereby they have difficulty in selecting the appropriate type of information from the vast array available. This illustrates one of the major issues associated with the introduction of new technology, namely that of its control. Ensuring that the technology does not dictate the way each scheme's functions has been a noticeable problem.

Most of the staff using the computer - dispatchers, managers and clerical staff - have had little previous experience of computer applications and have therefore tended to use the programs and routines as given, altering their pattern of work to fit in with the computer requirements. In some areas, as previously noted, this has had a beneficial effect and has improved both individual performance and introduced a discipline to scheme management that was formerly missing, as well as encouring team work by pursuing common objectives. In other areas, however, the effect has been the opposite and much time has been wasted on coping with computer operations. Examples of the latter have been the generation of non-standard reports, data base filing and in editing the main program with the word processor. Whilst these problems are specific to each system they do illustrate generally the need for proper understanding and training in both computer operations and applications, even where a dedicated system has been installed. This is especially true where, as in these schemes, no systems manager was available to advise on use and correct mistakes when made.

From interviews conducted with operating staff and from direct observation of them at work, it is obvious that many of them feel dominated by the system and lack confidence in operating the computer software, apart from the routine functions. This means

that the potential power of the computer is not being utilised to any where near its possible extent, and that if the scheme objectives or working practices change the computer system will not be modified to take account of these changes. Indeed, this fact alone may well inhibit such changes and ironically the 'new technology' might hold back necessary reforms. From initial observations and discussions with the staff it is clear that the benefits of computerisation are understood but the implications for the staff and operating procedures are clouded by misunderstandings about the role of computers and by the mystique of computers generally.

Two problem areas have been identified as requiring further research and development. Firstly, there is the need to train people in **operational skills** which includes keyboard operations, function keys, security procedures, loading and copying programs, and simple commands which enable them to at least feel that they can control what is happening and let the computer respond to them rather than the other way round. Secondly, key personnel in an organization need specific training in **application skills**, such as programming, compiling programs, modifying file structure and in setting up the use of software programs like word processors. Application skills are more to do with understanding the logic of computer programming and are experiential: operational skills are acquired from instruction and by repetitious learning. Successful implementation of a computer system requires that both sets of skills are available within an organization.

These two levels of skills in computer system management can be further enhanced if development skills are also available to analyse the use of the computer equipment and suggest modifications to existing applications or new areas which would benefit. Opportunities for IT applications in transport operations are expanding all the time and scheme managers were aware of the need to keep abreast of new developments and of the obsolescence problem of existing equipment.

The national survey mentioned earlier recorded some of these misgivings as perceived by CT operators. The survey data revealed that 61 projects (10 per cent) were presently using computers or planning to do so in the near future. With the exception of one or two, all the applications were on stand alone microcomputers using general business software. Most users were self-taught and recognized the limitations of existing software and of their own skills in developing appropriate applications, and in response to a question on their training needs indicated their willingness to improve and update their knowledge and skills in the areas of computer operations and software applications.

The impetus to apply computers in CT projects is not determined by the need to improve economic peformance or productivity, although it is acknowledged that these may be indirect benefits: rather the objectives have been to reduce administrative

procedures which take time and require a significant staff input; and to record more accurately the operation of the scheme in order to meet existing demands and new requests and respond to the needs of the transport deprived as a social service.

These objectives are important in helping to shape and define the functions of computers in community transport. The 'means' of computer applications - data processing - is closely related to the 'ends' - social needs - and just as elsewhere, the means are justified by how well they meet the end conditions. These aspects are often forgotten in IT applications and it is all too easy for personnel to get caught up in the culture and jargon of computerisation and to forget the end user and the raison d'être of the application in the first place. These words of caution are expressed because during the investigation it has become apparent that the gap between the computer literature and non-literate is growing, with the possible danger that *afficionados* of IT will widen this gap as they pursue more computing power.

These are not merely technical issues but also social issues, raising questions about the usefulness of IT where the aims are not clear, the training needs of staff in various levels of application, and also regarding the use of the output - the data - and whether this is used to further the aims of the project or more naively to justify the use of the computer. Computers are powerful tools with many valuable and relevant applications in transport management and control which are not yet being fully harnessed to the needs of the end-users, partly because the end-users are often ill-equipped to use them and also because the design of the hardware and software is dictated by the 'means' rather than the 'ends'. The purpose of our research is to address this imbalance and assess how the end users can really get the computers to work for them.

Future Developments

These issues have been considered by the Development Group, and arising from the discussions has emerged a proposal to develop a modular software program which is dedicated to the needs of community transport, brokerage and dial-a-ride systems, whilst retaining the flexibility to modify the software to individual requirements. Funding to develop a suitable software package is being sought and if successful it should be available in 1988.

It is also our intention to join with Community Transport Magazine in establishing a national network of CT groups using computers which can support each other in software applications. The object is to compile a central data base of computer users and current applications at Loughborough University which would be made available to user groups, and to use the data base to encourage regional networks of mutual support. This networking system should begin by the end of 1986.

Finally, considering the training issues mentioned earlier, the IT in CT project is organizing a number of training events both in-house at Loughborough University and at national and regional conferences on community transport. It is also the intention to write an introductory handbook and guide to computer applications for CT sector agencies.

Conclusion

Much of the research and development into computer applications centres on technical questions, such as programming or the design of software architecture. Whilst these considerations are obviously important, to many end users they are issues which appear too complex or remote from the day to day management perspective. There is a need for social research which alternatively focuses on the management issues and how the computer impacts upon these functions.

Specific items of interest identified in this research project include:

- the training of staff in general computer operational and specific application skills, and of managers in development skills and their awareness of computerisation possibilities;

- the impact of computerisation on administrative functions, such as accounts or word processing, and the costs and benefits from economic and social viewpoints. Experience from our evaluation so far suggests that the benefits outweigh the costs once the opportunities have been identified and the software correctly applied to the problem;

- the problems of information control. Once a computerised system is in force vast amounts of data can easily be generated. This process requires selection and control and careful monitoring, and in our experience can provide data which is useful in evaluating scheme performance, such as vehicle utilisation and assessing passenger needs. Properly applied the system can be used in the planning and forecasting of future needs or expansion in the transport service.

Information technology is a powerful new tool which, day to day, is becoming more accessible to even small transport operators. It can help in the administration and management functions and perform planning and forecasting tasks previously regarded as too onerous. This power needs proper control, and obedience to the 'ends' of the application rather than becoming a slave to the

'means'. Correctly applied, IT in CT could bring enormous benefits to the transport providing agencies, boost their image amongst policy-makers and arm them with the statistics they badly need to justify an expansion in special services, especially to the elderly and handicapped, at a time when govenment expenditure on public transport is declining. Arguably, this is the real social objective in special transportation planning, and computer applications will ultimately be judged by the same criteria of success or failure.

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TABLE 1: SUMMARY OF THE OPERATIONAL CHARACTERISTICS OF FOUR DIAL-A-RIDES AND A COMMUNITY TRANSPORT BROKERAGE SCHEME

	Birmingham Ring and Ride	*Haringey Dial- A-Ride*	*Manchester Ring and Ride*	*Nottingham Dial-A-Ride*	*Nottingham Comunity Transport/Brokerage*
Operating Area	50 km^2 Central and North West Birmingham	33 km^2 Borough of Haringey (North London)	40 km^2 Central and North-East Manchester	67 km^2 Nottingham City and Suburbs	67 km^2 Nottingham City and Suburbs
Target Population	People with limited mobility unable to use conventional public transport.	People with disabilities	People with limited mobility unable to use conventional public transport	People with disabilities unable to use conventional public transport or other statutory special services	Transport disadvantaged
Number of small Passenger Vehicles	5	4	3	2	6
Estimated Total Annual Operating Cost (1985) in £'s	303,000	130,000	243,000	—— 45,000 ——	
Total Registered Users	2433 (April 1986)	1342 (Nov. 1985)	1560 (May 1986)	218 (Feb. 1986)	158 Voluntary Organizations (April 1986)
Average Monthly Passengers (1985)	4815	1944	2055	465	-
Average Vehicle Occupancy (passengers per vehicle trip)	1.12	1.25	1.35	1.35	-
Refusals and Cancellations %	3	14	11	25	-
Computer Applications	Booking trips Data analysis of the passenger, trip and vehicle records. Word processing Data base management	Booking trips Data anlaysis of the passenger, trip and vehicle records. Accounts	Booking trips Data analysis of the passenger, trip and vehicle records. Data base management	Booking trips Data analysis of the passenger, trip and vehicle records.	Data base management Invoicing Word processing

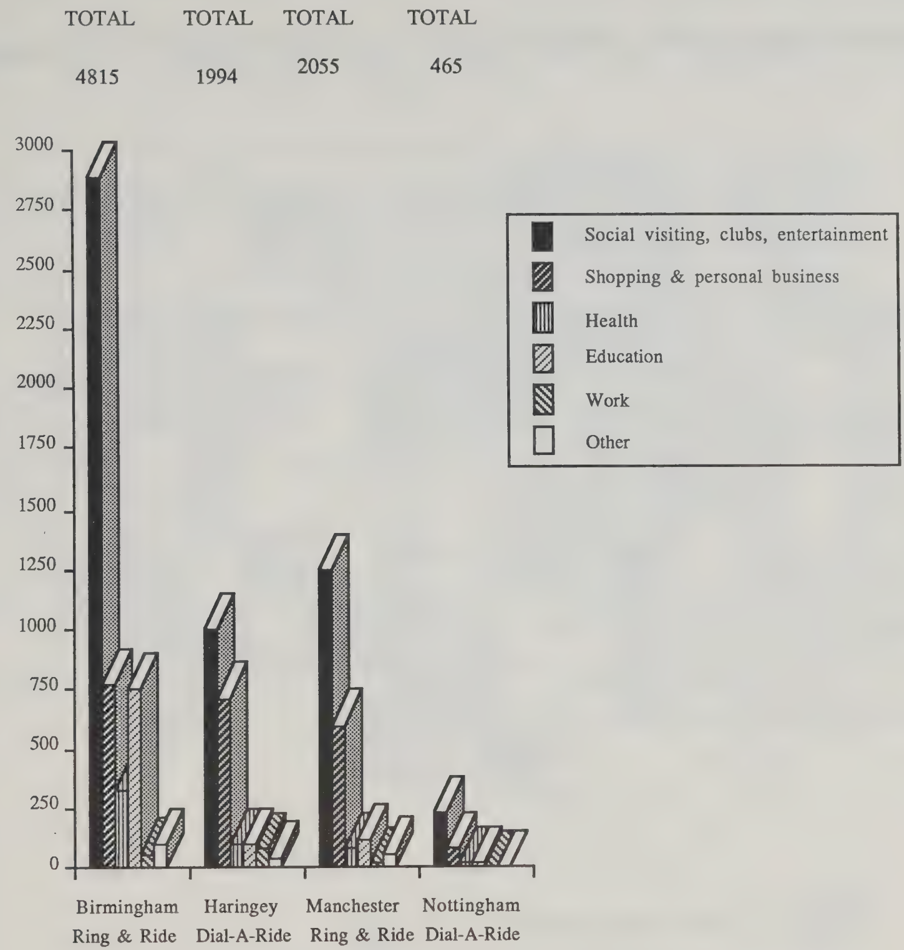
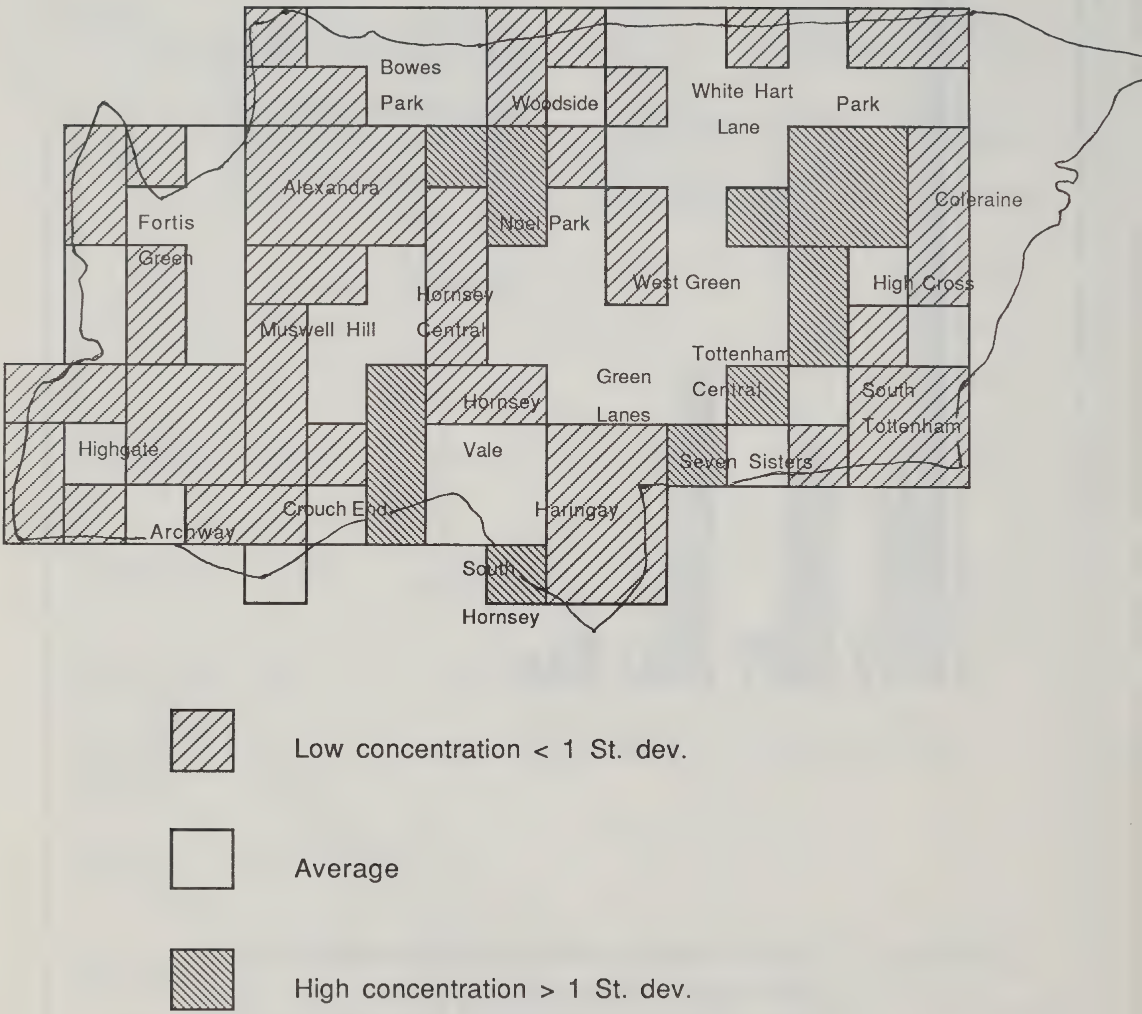
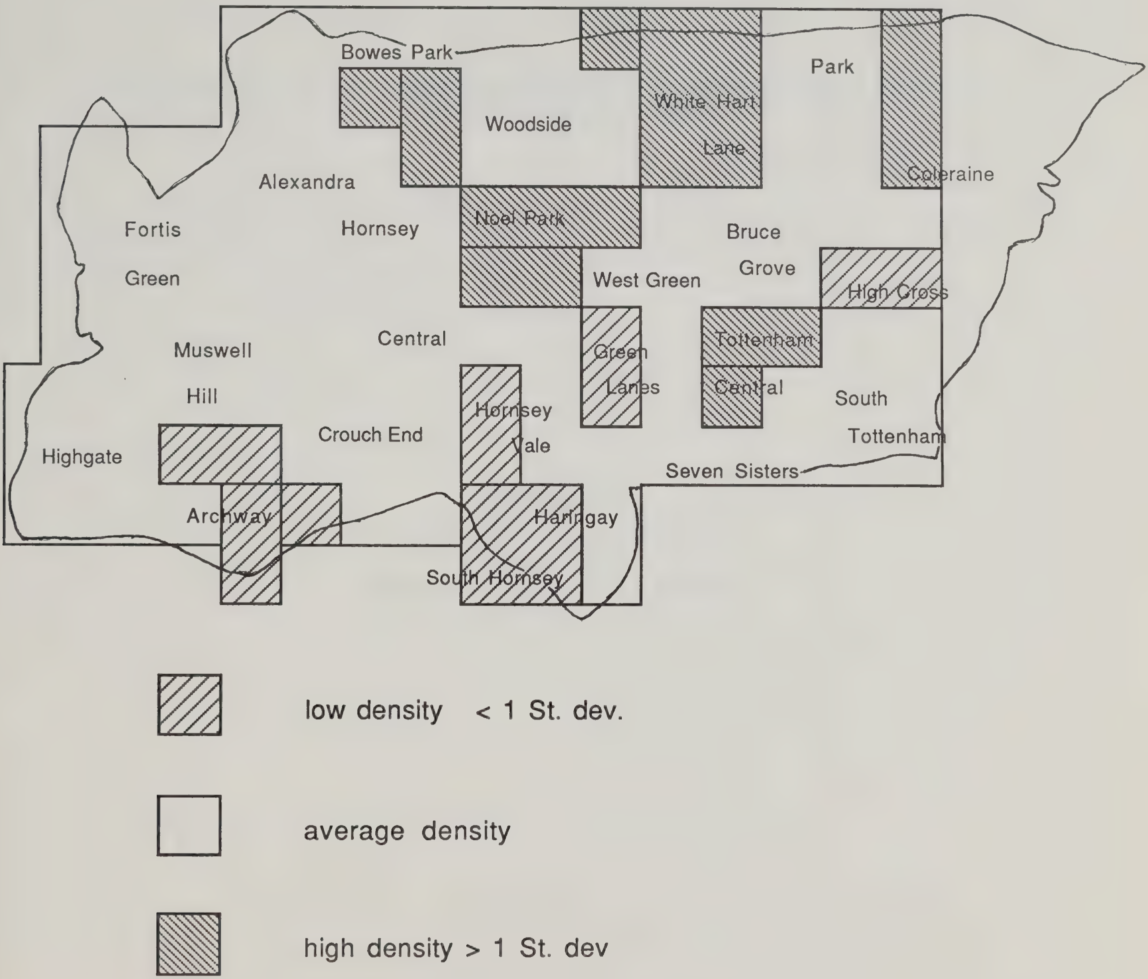


FIGURE 1 : PASSENGER TRIPS CATEGORIZED BY JOURNEY PURPOSE IN FOUR DIAL-A-RIDE SCHEMES (Monthly Average 1985)

Map 1a. Concentration of Trip Origins and Destinations in Haringey



Map 1b. Population Distribution of Elderly and Handicapped People in Haringey (source: 1981 Population Census and Haringey Borough Planning Department)



IMPLEMENTATION OF COMPUTER SYSTEMS FOR SPECIALIZED TRANSIT: THREE CASE STUDIES

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IMPLEMENTATION OF COMPUTER SYSTEMS FOR SPECIALIZED TRANSIT: THREE CASE STUDIES

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1. Introduction

The operation of specialized transit services for the elderly and the handicapped involves complex registration, reservation, scheduling and dispatching tasks and the production of numerous management reports for internal and external use. This context, combined with the need to provide more service per dollar, has led many properties to consider computerized aids. In this paper we will describe the ongoing implementation of computer systems in three Canadian cities: Montreal, Toronto and Sherbrooke. We also present some general conclusions on the design, installation and use of computer-assisted paratransit systems.

The Montreal system, installed on a large IBM mainframe, permits advance and demand-responsive scheduling while the client is waiting on the phone. The Toronto system, installed on a dedicated minicomputer, is geared to advance scheduling followed by a call-back process. Both systems use scheduling algorithms based on recent work by the University of Montreal's Transportation Research Centre funded by Transport Canada (1). These are large-scale operations, handling between 1200 and 2000 trips per day and serving large metropolitan areas. The Sherbrooke system is typical of requirements for smaller properties (200 trips per day). It is being implemented on a micro-computer with a hard disk. These systems were developed by GIRO in cooperation with the respective transit companies. Major funding has been provided by the Quebec and Ontario governments.

2. Functions of a computer system for specialized transit

The functions of a computer system for specialized transit can be categorized as follows: client registration, trip reservation and confirmation, trip scheduling, dispatching, operations reporting, management reporting, and financial functions. The various systems in operation in Canada (2) permit partial or full automation of some or all of these functions. However, the relative emphasis placed on the various functions varies greatly. For example, in cities where several vehicle operators or taxi companies provide the actual service, operations reporting and financial functions tend to be emphasized. For smaller operations, the scheduling task is often less automated than in larger cities: in the latter case, the size of the demand necessitates a coordinated effort between several schedulers. The mix between subscription trips, advanced bookings and demand-response trips, as well as the presence or absence of a confirmation process, greatly affect the

type of system required. Finally, a series of details have important consequences on scheduling software: do schedulers and dispatchers provide both pickup and drop times to drivers, or do they only provide pickup times, leaving the detailed routing to the driver?; is the service forced to refuse a significant number of requests because of insufficient vehicle availability or are almost all requests honored?; what kind of service flexibility is allowed between requested trip times, scheduled times, and effective on-the-road times?

Each locality therefore has a unique mode of operation based on client service policies, the size of the demand, funding levels and policies, and the division of responsibilities between public transit authorities, private bus operators, taxi companies and government agencies. The bottom line is that, except for the simpler functions, it is impossible to define a generic software system that will suit everyone: at the least, a significant amount of customization is necessary for each installation of an established package.

GIRO's approach, therefore, has been to develop a modular system designed for adaptability from one property to another and from one type of computer hardware to another. Written in standard COBOL, the system permits an evolution in the level of automation provided, by the addition of optional features and functions in the following order:

- computerization of the client database;
- computerized reservation with manual scheduling using printed trip request forms ("trip tickets");
- computer-aided scheduling using a route suggestion algorithm;
- automated scheduling on a trip-by-trip basis using a detailed zone-to-zone travel matrix;
- global route optimization using advanced algorithms.

This approach has the advantage of being open-ended and flexible and we feel that it offers the best guaranties for evolutionary growth as paratransit services expand and as we gain more experience with computer-assisted scheduling. Experience has also shown that the introduction of complex and costly scheduling systems must be preceded by the installation of a sound data processing system, including the generation and validation of client, trip and travel time data. Computer response time, for example, is critical: the most advanced algorithms are of little use if execution time is excessive.

3) Goals and measures of effectiveness

It is common adage of the computer business that it is essential to clearly define one's needs and goals before proceeding with system design or procurement. What are these goals for specialized transit and how can we measure, quantitatively, our success in achieving them? Globally, the thrust is to provide the best quality service at a reasonable cost, but

this statement of goals is both too general and too subjective. More specific measures include the following:

a) vehicle productivity in trips/hour, customers/hour, or customers/kilometer;

b) cost per customer trip in dollars, including on-the-road costs, reservation and scheduling costs, and administrative overhead;

c) average telephone dwell time for the trip reservation process;

d) scheduling lead time (how long does it take to schedule and confirm a reservation) or a batch of reservations;

e) service quality measured firstly, by the difference between times confirmed to customers and effective pickup and drop times, and secondly, by the number of scheduling errors or omissions;

f) percentage of rejected trip requests;

g) lead time and person-hours required to produce daily operating statistics.

Some of these measures are controversial and somewhat ill-defined and comparisons from one property to another are often difficult. Relative measures, however, taken before, during and after computerization of specific functions can and should be used to judge effectiveness. Other more subjective criteria, such as system acceptance by drivers, office personnel and management, should also be evaluated.

With these measures in mind, we will now examine more closely some specific examples.

4. Montreal

The S.T.C.U.M. in Montreal manages and operates a customized transit operation with approximately 40 buses. Extensive use is also made of taxis in several portions of the service area. The approximately 1200 trips per day are divided roughly between 40-45% subscription, 40-45% advanced bookings (one or two days in advance), and 10%-15% demand-responsive. Since there are no call-backs, an immediate confirmation of pickup times must be given while the customer is still on the phone.

The major goals of the S.T.C.U.M. were to reduce telephone dwell time (and thereby also reduce telephone congestion), to increase bus productivity, and to produce more timely and complete information concerning operations.

At the present time, the client registration and trip reservation functions have been operational for 18 months while the scheduling of advanced trips using the computer has been introduced gradually over the last three months. Same-day scheduling and dispatching is slated to go live at the end of 1986.

Results so far are very encouraging: telephone dwell time has been reduced significantly as the computer automatically suggests candidate runs and inserts the requested trip into these runs where possible. Dwell time was a particular sore point with customers, as manual scheduling could take up to 20 minutes. Vehicle productivity has also been increased by 10 to 30%, and, at the same time, service quality has been improved by reducing the gap between scheduled and effective pick-up times.

Computer-generated run sheets are particularly appreciated by the drivers, as they contain more detailed and legible information than the previously handwritten ones, including the sequence of pickups and drop offs for many-to-many and one-to-many type itineraries.

The system functions in the following manner: once trip information has been entered (see Figure 1) the call-taker books the request and then proceeds to schedule the outgoing and return trips. The run suggestion algorithm is normally used to identify vehicles with trips that could be "matched" in space and time with the new requests. These suggestions are then verified by the user and the system will insert the trip into the run if travel times and service criteria are met. The call-taker can over-ride system-assigned times if necessary, but this is rarely done (see Figure 2). Scheduling criteria include "windows" around requested and confirmed pickup and drop times, maximum travel time permitted, and vehicle capacity and type. The algorithm used is designed to minimize vehicle movement and to share rides as much as possible.

For use by this system and by others, Montreal Island has been divided into 502 one-half mile by one-half mile zones. A distance matrix was generated using Statistics Canada's network model of Montreal streets, and therefore takes geographical barriers into account. Travel time estimates were then generated using these distances, by applying a vehicle speed model which takes into account zones of congestion and rush/off-peak hour speed variations. Loading and unloading times are added for each stop depending on the number and type of passengers. Travel time estimates have been found to be remarkably good, with little or no deviation from estimates made by experienced schedulers.

Once the scheduling process has been completed, a senior scheduler examines all the runs for any problems and may make adjustments to improve productivity and quality. The "blessed" runs are then printed and given to the drivers at the beginning of their shifts (see figure 3).

The system is installed on a large IBM mainframe which supports a network of several hundred terminals. Thirteen terminals and six printers are used by specialized transit personnel. The shared use of a central mainframe has the advantage that a large operations support staff is available and that expansion can be handled quite readily; the disadvantage is the complex nature of the system software (VSAM, CICS, OS/VS) and the organizational and operational overhead involved.

The major difficulties encountered in Montreal were typical of those found in most large software development projects: the system took longer to develop then was planned, the original specifications were found to be lacking in several respects and considerable fine-tuning of the software

was necessary to meet detailed requirements and to maximize speed of execution. The scheduling method originally proposed was replaced by a more effective one developed after the specifications were first drawn up. These scheduling algorithms, developed in the university environment, had to be completed so as to function correctly with real-world constraints. In total, the system is comprised of nearly 80 programs and 100,000 lines of code.

For the S.T.C.U.M., job reclassification, training, and equipment installation constituted delicate and lengthy tasks. Start-up data entry and validation, of the client, common address, and master schedule files, proved to be a non-negligible supplementary load during the implementation process. This extra load must be taken into account when planning time tables and budgets.

Finally, the close scrutiny of existing procedures and master schedules, rendered necessary by the computerization process, brought out several anomalies that had to addressed and corrected by management. It should be mentioned here that management support, essential in projects of this nature because of the large-scale changes in working methods involved, has always been forthcoming in the three installations discussed in this paper.

5. Toronto

The T.T.C.'s Wheel-Trans service is probably Canada's largest with nearly 100 vehicles and approximately 2000 trips per day. The mode of operation focuses on scheduling for maximum vehicle productivity: clients reserve trips, these are scheduled at some later time, and the exact pickup time is then confirmed by telephone. The computer system has permited, through various information-handling and scheduling aids, a significant speed-up in the reservation-scheduling-confirmation cycle. Presently, reservations are taken up to seven days in advance because of the lead time previously necessitated by the manual system; with the computer, the lead time has been cut by several days.

The telephone dwell time has been slightly reduced, with the help of a number of data-entry aids, to the 70 to 100 second range. Client addresses, for example, are automatically filled in on trip requests, and a bank of previously-used trips is maintained for each regular user. Abbreviations for commonly used addresses are also provided. Faster response from the computer could permit more dramatic gains in this area.

Data now flows throughout the office via the computer, eliminating the need to fill-in and read handwritten forms as well as a substantial amount of recopying of information onto the schedules and from there onto the driver sheets. The number of errors due to misplaced requests has been reduced, as have double or conflicting bookings. As an added advantage, personnel with physical handicaps that make writing difficult have reacted very favorably to the use of keyboards.

The scheduling process starts with a survey of trips waiting to be scheduled. These requests are stored in the computer in "holding" runs created automatically by hour and by major geographical zone. The schedulers use computer commands to move trips from these holding runs to the vehicle runs. Several schedulers can attack the same schedule at the same time, thus diminishing the lead time. The computer facilitates the manipulation of the large amount of information involved and eliminates tedious recopying when adjustments are made. Once the bulk of the scheduling has been completed, left-over requests or last-minute "plug-ins" are inserted when and if possible. Here, the system's run suggestion algorithm can be used to locate candidate vehicles.

Pick-up times are confirmed to clients by a call-back process, again using computer terminals to list all of a particular clients trips for the day. Any cancellations received before the printing of the driver run sheets (see Figure 3) are automatically removed from the vehicle stop list.

Using this process, vehicle productivity has been increased by 5% to 10% in the first three months of 1986 over previous levels. This represents a significant amount of potential savings in cost per trip in an operation the size of Wheel-Trans.

Another major benefit of computerization is an important reduction in both the elapsed time and the person-hours required to produce operating statistics. Furthermore, the quantity and quality of information produced is much better, and via a link to a personal computer with graphics capabilities, many charts used for planning and reporting purposes can now be generated automatically.

The equipment used in Toronto is a dedicated minicomputer with approximately 30 terminals, 2 medium-speed printers and one laser printer. Hardware upgrades are presently being considered to improve response time during periods of peak activity, to handle the ever-increasing demand and to support the extra load projected with the use of the dispatching function: it has been found that the scheduling function, particularly, is a heavy consumer of computer resources.

The major difficulties in Toronto were similar to those in Montreal: staff training, delays in equipment and software delivery, changing specifications as the service evolved, the burden of start-up data entry, and the necessity to fine-tune the system for speed, ease-of-use and reliability. The computer has, however, in a short time been accepted as an indispensable tool. Indeed, backup considerations have become very important because of the increased dependency on system availability.

6. Sherbrooke

At the time of writing, the Sherbrooke system has been delivered but is not fully operational. The major problem remaining to be addressed is that if improving reservation and scheduling time. In a smaller property, the human scheduler can normally keep track of what is available and scheduling time is minimal. Scheduling aids are useful,

but the main thrust of such systems is to help manage information on clients, trips and schedules and to automate reporting. The challenge therefore is to get the necessary information into the computer while the client is on the phone, without unduly increasing existing dwell time.

Another issue that has been raised is the utility, in smaller operations with relatively simple routes, of providing detailed scheduling of pickup and drop sequences to the drivers. This obviously has important implications for the way in which scheduling information is entered and stored in the computer.

The work in Sherbrooke has nonetheless already had a beneficial impact on the operation of the service. Statistical measures have been clarified and refined. Operational policy and procedures have been closely examined and the groundwork laid for olderly growth of the service without adding new personnel.

7. Conclusion

For all of the installations described above, work is continuing on adding new functions or improving existing ones. In both Montreal and Toronto, as mentioned, the dispatching function is to be automated later in 1986. Experimentation is also being carried out in collaboration with the University of Montreal in the area of advanced optimization algorithms designed to improve existing scheduling methods. Other developments that could be seen in 1987 include the use of graphics displays for dispatching and the use of a sophisticated planning tool to better match service hours with customer demand for trips.

The computer has earned its place in most large handicapped and elderly transportation services and in several smaller ones, and while the field is far from mature, a few systems with proven effectiveness and varying levels of automation are now available on the Canadian market. The Toronto and Montreal systems, in particular, have demonstrated the usefulness of the computer in the scheduling function by helping to produce better schedules in less time.

Roy, Serge et coll. "Routing and Scheduling for the Transportation of Disabled Persons: the algorithm" Transport Canada, 1985.

Transvision Consultants "Application of Computers to Special Transit Services". Transport Canada, 1985.

```
CLIENT MENU                               WHEEL-TRANS                      TRAX:15/11/85:1130
      ID: 00103         NAME: MRS                              , JOAN
APPROVAL: 30/04/82   EXPIRY:   /  /     BIRTH: 14/02/1937   SEX: F   SUSP:
DISABIL : 0023   MOBIL: W                          OXYGEN:     MAIL RETURN:   /  /
LANGUAGE:          IMPAIR:       ESCORT:             TEMP: P   LAST SERVED: 04/10/85
COMMENT : SUBSCRIPTION RIDER

                                       TRIP-ID: 02 A
DP: HOME                                          ADD:
# :         BO:         ZONE:   /  / -    INTERS:
PH: (    )   -           EXT:                  NOTES:
AR: TW                                            ADD:
# :         BO:         ZONE:   /  / -    INTERS:
PH: (    )   -           EXT:                  NOTES:
 S M T W T F S      PAX    REQ TIME  D/A   FLEX    -   +     START       END
     A             AOW10     1300     A           15  00   DD/MM/YY   DD/MM/YY
CANCEL START: DD/MM/YY       RESUME: DD/MM/YY
    COMMENTS: HAS CANC SUB
                                                           RETURN: 1400 -    +
```

Figure 1: Trip request data entry screen. This request is for a two-way trip the following Tuesday from TW (a common address) to the client's home address.

```
SCHEDULED RUN LIST                 WHEEL-TRANS                          :15/11/85:1144
    RUN:B004    START:0630      END:1830      STATUS:300       SCHEDULE:851115
                SLACK:1200                     PROD.:01.7            OW:00
 NO  ETA  CLIENT TRP  PAX  ADDRESS                            ZONE     STAT. REQ. DEV. OW
*************************************************************************************
001 +0645  00133 80A AOW1  100 HIGH PARK AV                  73/96/3-4 S B

002 -0705  00133 80A AOW1  89 GOULD ST                       74/80/3-  S B   0705 +000
003 +0710  10747 80A AOW1  121 SCADDING AV                   74/70/2-  S B
004 +0720  03005 80A AOW1  192 JARVIS ST                     74/70/4-  S B
005 +0730  17577 81A 10W1  25 ELM ST                         74/84/ -  S B
006 +0730  16405 80A AOW1  25 ELM ST                         73/77/1-  S B
007 +0740  00325 80A AOW1  341 BLOOR ST W                    73/99/3-  S B
008 +0740  02604 81A AOW1  341 BLOOR ST WEST                 73/99/3-  S B
009 -0745  16405 80A AOW1  170 BLOOR ST W                    73/99/2-  S B   0800 -015


010 -0815  02604 81A AOW1  5100 YONGE ST                     84/61/3-  S B   0830 -015
011 -0820  10747 80A AOW1  4900 YONGE STS                    84/50/1-  S B   0815 +005
012 -0820  03005 80A AOW1  4900 YONGE ST                     84/50/1-  S B   0815 +005
013 -0820  00325 80A AOW1  4900 YONGE ST                     84/50/1-  S B   0815 +005

* CAN SCH PRT ACC NXT HLD LST DEL ETA PRA BLS  * FUNCTION>    STOP>    TIME>
```

Figure 2: Scheduling screen. The system inserts the new request into the run if possible. The scheduler can modify run information as required.

Date 8609C1 Heures d'assignation	Jour LUNDI 06:5C-10:35	Service du Transport Division Transport adapté	FEUILLE DE ROUTE	Km à l'arrivée Km au départ
Numéro du véhicule		Tournée 0615	feuille 1	Km parcourus

Heure appel	Heure Emb./Déb.	Heure arrivée	Amb Fauteuil	Nom adresse,	Municipalité zone	Heure départ	Tarif
1	E07:25		AM00 FA01 ESO	CLAIRE [redacted] [redacted] SHERBROOKE OUEST	CEC 100B2		
2	EC7:40		AM01 FA00 ESO	MICHEL [redacted] [redacted] CNTARIO EST	CEE 1C1A2		
3	EC7:45		AM01 FA00 ESO	JACQUELINE [redacted] [redacted] RCBIN	CEE 101A2		
4	E07:55		AM00 FA01 ESO	ANITA [redacted] [redacted] BCUL DE MAISONNEUVE ST	CEE 1C1B2		
5	E07:55		AM00 FA01 ESO	ISABELLE [redacted] [redacted] DE MAISCNNEUVE EST	MTL 101B2		
6	E07:55		AM00 FA01 ESO	GUY [redacted] [redacted] DE MAISONNEUVE EST	CEE 101B2		
7	DC8:30		AM00 FA01 ESO	ISABELLE [redacted] [redacted] ST HUBERT	PMR 082B3		
8	DC8:30		AM00 FA01 ESO	GUY [redacted] [redacted] ST HUBERT	PMR C82B3		
9	DC8:30		AM01 FAC0 ESO	JACQUELINE [redacted] [redacted] ST HUBERT	PMR 082B3		
10	DC8:45		AM00 FA01 ESO	CLAIRE [redacted] [redacted] DANDURAND / IBERVILLE THERESE GILBERT 274-5571	ROS 083B2		

Code 10-300 Accordé à	Heure	Entré au garage à	Heure	Signature	matricule	Nombre de voyageurs

Figure 3: Run sheet

OPERATIONAL CHOICES FOR SPECIAL TRANSPORTATION: USE OF COMPUTER SIMULATION TESTS

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and
Senior Services of Snohomish County
Everett, Washington
United States of America

OPERATIONAL CHOICES FOR SPECIAL TRANSPORTATION: USE OF COMPUTER SIMULATION TESTS

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Problem Statement

Senior Services of Snohomish County, based in Everett, Washington, operates the 17-van DART Program which provides service for elderly and disabled Snohomish County residents scattered over much of the county's 2,098 square miles. The county is characterized by substantial urban and suburban development in and around the city of Everett and to the south toward Seattle, 35 miles away. The balance of the county is very rural with a number of towns and small cities.

DART has been operated with a mix of prescheduled and demand-response services that has resulted in development of some loosely defined, long routes radiating out from the DART vehicle base, south of Everett. DART managers wondered if some other service configurations might improve productivity and lower operating costs.

One approach, called the zone concept, could have value in concentrating service in smaller service area areas -- zones. Efficiencies might improve through reductions in trip length, potentials for improving vehicle occupancy rates, and possible reductions in deadhead miles and time.

Other possible service configurations include a formalized route structure, route-deviation service (under which vans can leave a route for short detours to pick up passengers on a prearranged basis), and continuation of the current informal routing.

Finally, DART managers wondered if there might be benefits to out-stationing vans instead of basing them all at a single location. With the current central base located south of Everett, some vans generate extensive deadhead miles and time enroute to the base.

A capacity to test these concepts without putting them into operation would benefit system users who might be disrupted if a field test was conducted. Rather than institute any of the concepts untested, it was proposed that a computer simulation be used to explore the ramifications of making service pattern changes. The simulation was developed by

combining Senior Services' staff's computer capacities and van program operational experience and the availability of data in DART's client record files with funds and planning support from the county-wide transportation planning agency, the Snohomish County Transportation Authority.1

The Overall Project Design

Given the problem statement, the objective of the simulation design was to provide a tool for special transportation service planners and managers that could help formulate and test operational strategies by means of visual images and statistical data on the computer. The goal of these strategies would be service productivity and quality improvements.

The focus here was not on exploration of available market or latent demand: DART has been operating at near capacity. Instead the focus was on analyzing and improving current service patterns. Like many paratransit systems, approximately 75 percent of DART's requests are for regularly repeated or subscription-type service from long-term clients. Hence the general trip routes are built around these recurrent requests since on any given day they constitute the majority of service demand.

Because of the emphasis on repeat trip and subscription service requests, the simulation project design used recent, historical data from these types of requests. Further, the project explored alternative ways to handle these standard trips and the route/service patterns they generate.

Software Selection

The selection of the software to use was governed by a number of factors. First, DART uses IBM micro-computers with color graphics monitors. Second, budget restrictions dictated using "off-the-shelf" software. Third, the data base format was crucial. DART already has a data base of client and trip request information on line. The data base management package in use is DBASE III. DART will be using this data base management package for its MIS applications. If the simulation project succeeded, it could be integrated into the MIS application as one of the utilities that the system manager could use to play "what-if" games to test new service concepts without disrupting regular service.

One of the major advantages of using an "off-the-shelf" data base manager software package is that several of the important file and record manipulation functions are already built into the software: These functions normally take considerable time to program. A side benefit is that

the software has relatively user-friendly commands and good documentation.

One of the drawbacks of using DBASE III is the program's execution speed. DBASE III uses an interpreter in executing the program, hence it runs slower than it would if it were programmed and compiled in a high level programming language like PASCAL or COBOL. The tradeoff was that DBASE III required less programming time and the project was completed within a very small budget.

While DBASE III was the software of choice in this project, it is feasible to use most relational data base packages to develop the same sort of simulation.

The Simulation Design

Because the simulation can only be effective if it is easily used by service managers and planners, the design had to be very graphic and very simple to modify. The following describes the elements that were developed to make an easily used work tool.

Map: The central visual frame of reference is the service area map displayed on the monitor screen. Instead of a full map with all the details, it was decided to display the grid format used by The Thomas Guide: Snohomish County Street Atlas and Directory,2 the book of maps used by DART drivers. Each square of the grid corresponds to a page in the map book. An experienced user of the map can easily relate the grid with a map of the service area.

Map Coordinates: The map coordinates are the basis for plotting trips (pick-up and drop-off points) on the screen. The map coordinates correspond to the page number and the grid format on the map. To plot the coordinates on the monitor screen, an algorithm was developed to convert the textual map coordinate to x-y coordinates that correspond to the scale of the map in use.

Request Record: Each trip request is a single record that contains the following data:

- Client name
- Pick-up/Drop-off map coordinates
- Pick-up/Drop-off times
- Pick-up/Drop-off addresses
- Trip/Route designation

Time: Time is used to determine the order/sequence of pick-ups and drop-offs. The user can change the pick-up and drop-off sequence by changing the time.

Trip/Route Designation: DART uses an alphanumeric code for run/trip/route designation. A request can be moved to an alternate route by simply changing the route designation (which in effect changes the configuration of the route).

The user is able to list all the requests for a single day on screen and edit or change some of the data such as the pick-up time and the route assignments. DBASE III has filter commands that can be used to manipulate all records that meet certain conditions. For example, one can set a filter in a file for all request records that have pick-up and drop-off map coordinates within a given zone and then display them or simply assign or reassign their trip/route designation.

There are two separate features in the simulation. The first feature allows the user to study a single tour/route/trip at a time and then superimpose several other tours/routes onto the display, one at a time, in different colors. This feature also allows the user to see changes in service parameters as the tours or routes progress. Parameters like average trip length, average trip time, number of passengers on board at each stop are of particular interest. Other information on service productivity such as deadhead miles, passenger miles, revenue miles and van miles is also displayed and printed out in a report format for future analysis.

The second feature allows the user to watch the progress of up to four routes simulated on the screen in different colors. A clock display on the right-hand corner of the screen gives the user the time relationship of the simulation. Thus, the user can understand both the time and space (or distance) relationships of the various tours. This can lead the user to see opportunities for reassigning riders to different tours to provide better or more efficient services to a given zone. In observing zone operations, one can also see probable transfer points for interzonal trips. This is where the clock feature is very important to determine the location of a van at a given point in time in relation to other vans operating in the same vicinity.

Conclusions

The development of this rather simple tool has proved worthwhile. While the van dispatcher probably has a good sense of what is going on, the system manager and service planners may not be able to visualize how the vans really operate and where efficiency might be improved. Using the simulation approach, the following operations are possible.

The user is able to select a tour designation and watch as the pick-up and drop-off points indicate the completion of

the tour. The user can change parameters and then monitor the effects of the change(s) on the tour's configuration. The user is able to see the interaction of up to four tours/routes simultaneously and get a feel for the time and space relationships of the vans operating in a specific area.

By color coding the tours/routes, the user can also see how requests in a given area are handled and see the possibility of zone formation. By using the functions of the data base manager, requests can be grouped by area and thus service demand for a given zone can be studied.

The user can also assess the use of the van assigned to a route. For example, on some of the DART routes, long hauls are made to provide transportation to one or two passengers. Alternative strategies were tested to see if the pick-up/drop-off time or the route assignments could be modified to achieve better system productivity.

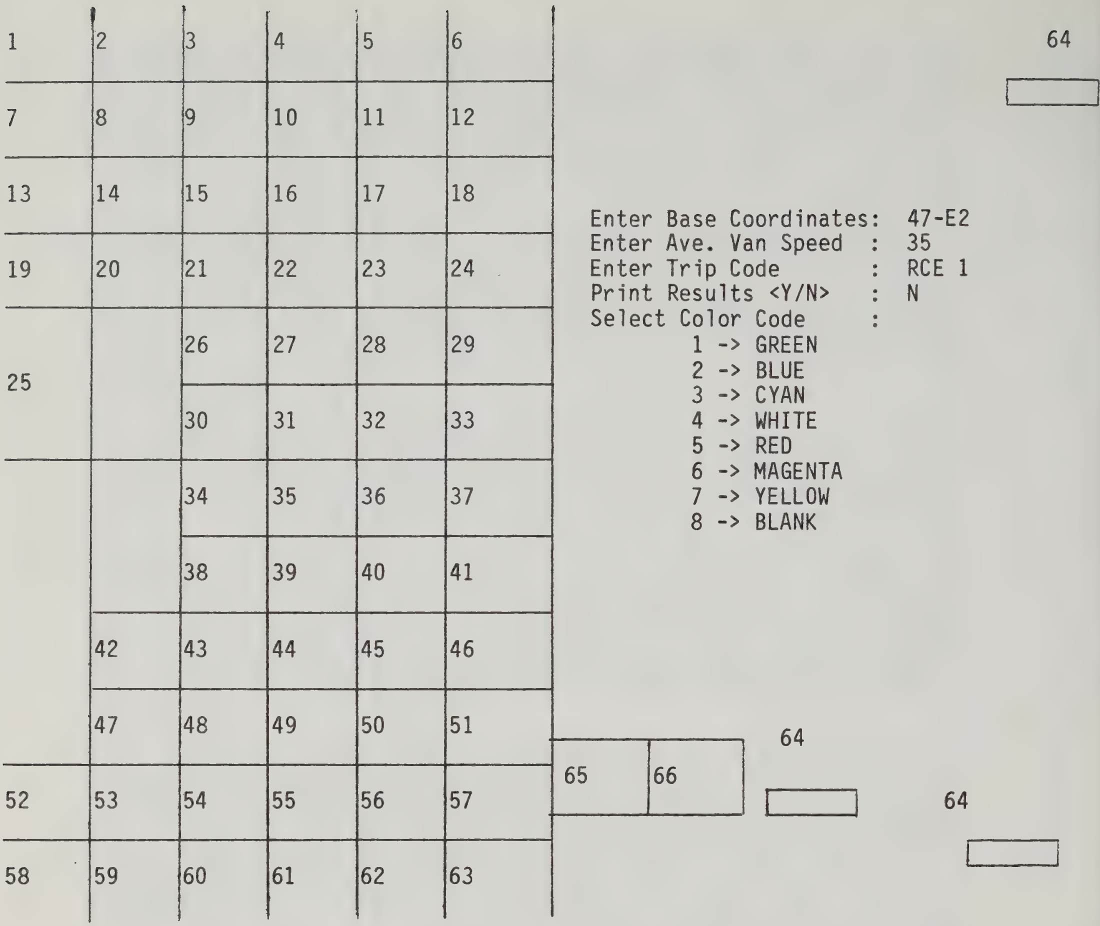
The user is also able to see where deadhead miles are being generated on different routes and test ways that trip configurations can be modified to reduce deadheading. In addition, the user can "relocate" the van base for problem routes to test whether different base locations (out-stationed vehicles) can reduce deadhead miles.

The implications of these simulations are clear. For a small amount of money and time, simulation of special services operations can help the manager determine whether to modify how service is provided, where routes can be maintained or reconfigured, how deadheading problems can be better identified, and whether instituting zones or entirely new route structures makes sense. This can be done with an agency's own trip records, a micro-computer and a relational data base program.

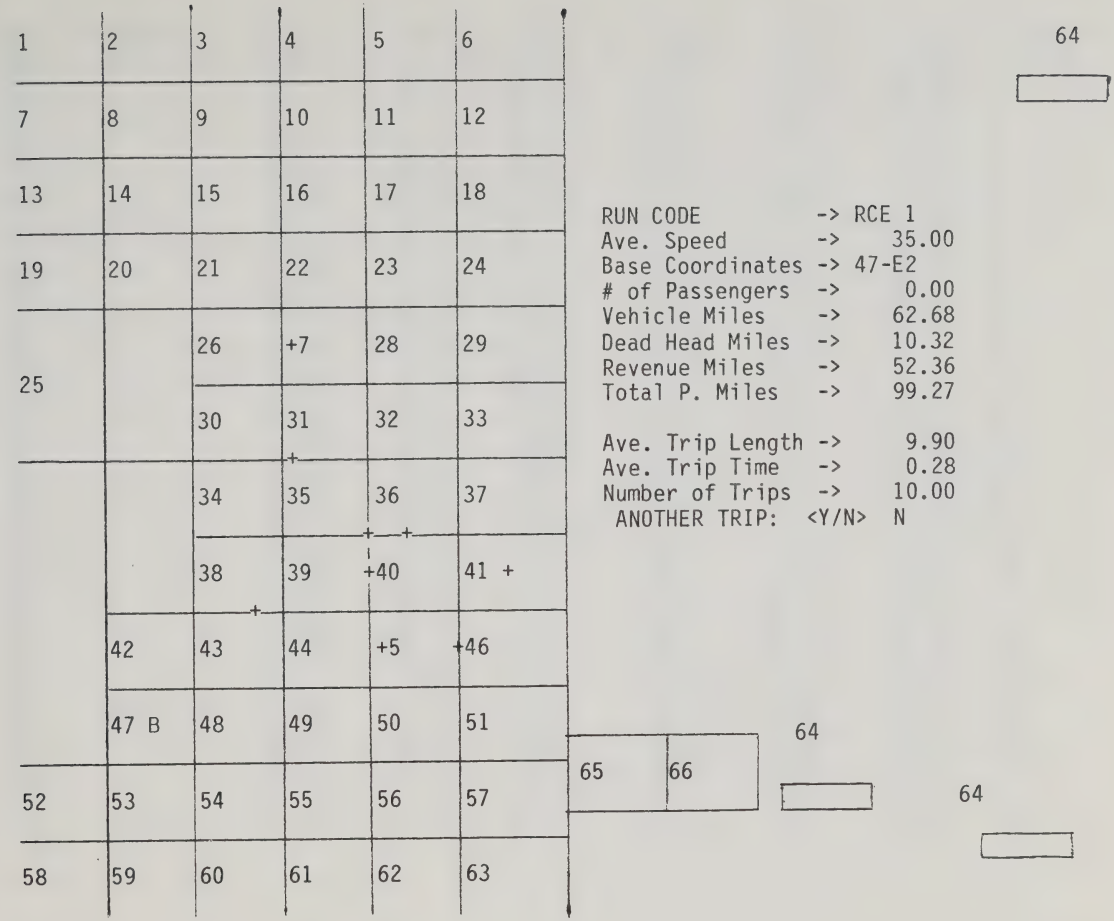
FOOTNOTES

1. This project was funded in part by the U.S. Department of Transportation, Urban Mass Transportation Administration and Senior Services of Snohomish County under the auspices of the Snohomish County Transportation Authority.

2. Published by Thomas Bros. Maps, San Francisco, CA.



This is the initial display of the first feature where the user chooses the route to simulate and the operating and display parameters in the simulation.



This is the display for the first feature of the simulation, where the user can watch a route in progress. The parameters on the righthand side are updated at every stop the van makes to either pick-up or drop-off a passenger.

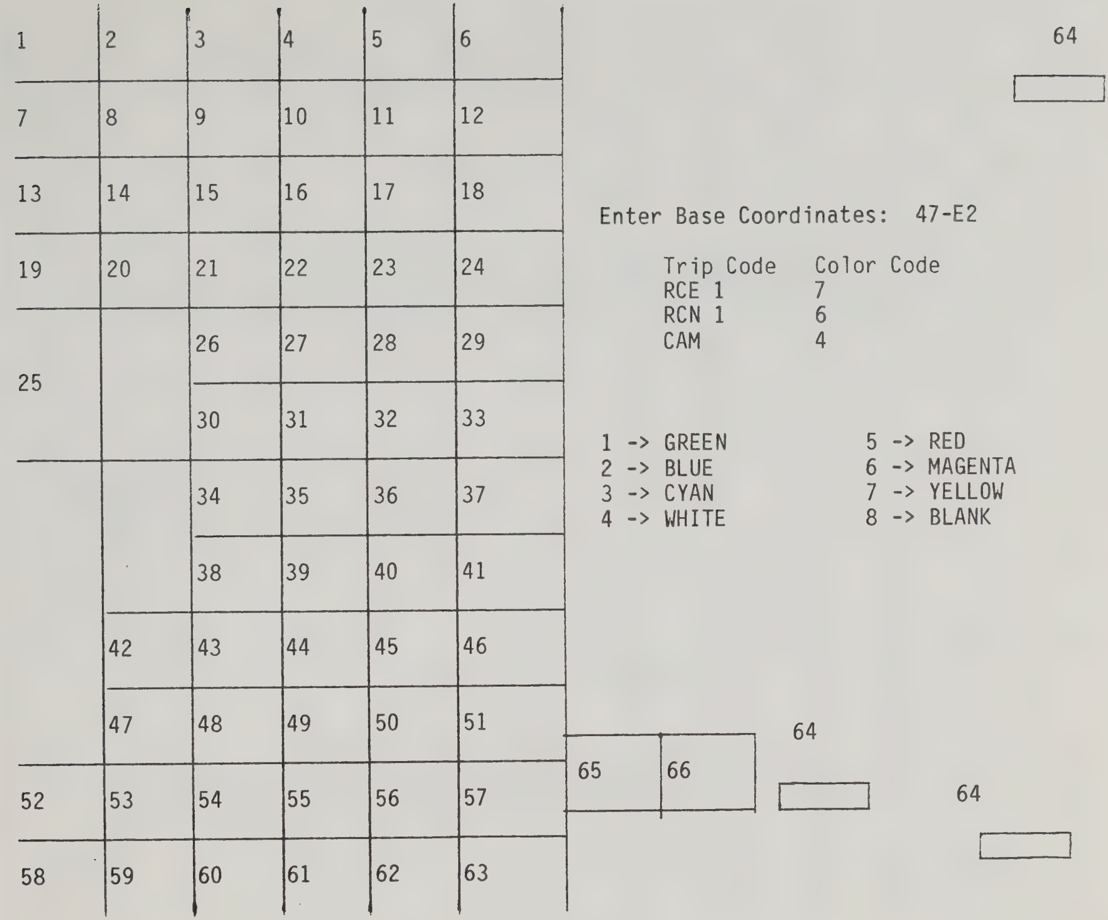
NOTE: The B in square 47 is the Base from which the van was dispatched.

Record#	OMC	DMC	DIST	NPASS	PM	CPM	DEADHEAD	TRIP
1	47-E2	48-B2	2.05	0.00	0.00	0.00	2.05	CAM
2	48-B2	34-F4	7.28	1.00	7.28	7.28		CAM
3	34-F4	14-B3	14.00	0.00	0.00	7.28	14.00	CAM
4	14-B3	13-F5	1.50	1.00	1.50	8.78		CAM
5	13-F5	07-E3	4.25	2.00	8.50	17.28		CAM
6	07-E3	07-E3	0.00	1.00	0.00	17.28		CAM
7	07-E3	02-B4	2.86	0.00	0.00	17.28	2.86	CAM
8	02-B4	02-A4	0.65	1.00	0.65	17.93		CAM
9	02-A4	02-B4	0.65	2.00	1.30	19.23		CAM
10	02-B4	07-E3	2.86	3.00	8.57	27.80		CAM
11	07-E3	07-E3	0.00	2.00	0.00	27.80		CAM
12	07-E3	07-E3	0.00	1.00	0.00	27.80		CAM
13	07-E3	29-D3	19.10	0.00	0.00	27.80	19.10	CAM
14	29-D3	16-F4	7.85	1.00	7.85	35.65		CAM
15	16-F4	07-E3	11.72	0.00	0.00	35.65	11.72	CAM
16	07-E3	07-E3	0.00	1.00	0.00	35.65		CAM
17	07-E3	07-E3	0.00	2.00	0.00	35.65		CAM
18	07-E3	07-D3	0.65	3.00	1.95	37.60		CAM
19	07-D3	07-D3	0.00	2.00	0.00	37.60		CAM
20	07-D3	07-D3	0.00	1.00	0.00	37.60		CAM
21	07-D3	07-D3	0.00	0.00	0.00	37.60		CAM
22	07-D3	02-A4	2.86	1.00	2.86	40.46		CAM
23	02-A4	35-F6	21.76	0.00	0.00	40.46	21.76	CAM
24	35-F6	35-FH	0.00	1.00	0.00	40.46		CAM
25	35-F6	10-D4	16.25	2.00	32.50	72.96		CAM
26	10-D4	10-D4	0.00	1.00	0.00	72.96		CAM
27	10-D4	38-D4	18.34	0.00	0.00	72.96	18.34	CAM
28	38-D4	38-D4	0.00	1.00	0.00	72.96		CAM
29	38-D4	45-B5	6.26	2.00	12.53	85.49		CAM
30	45-B5	45-D3	1.77	1.00	1.77	87.26		CAM
31	45-D3	47-E2	10.62	0.00	0.00	87.26	10.62	CAM

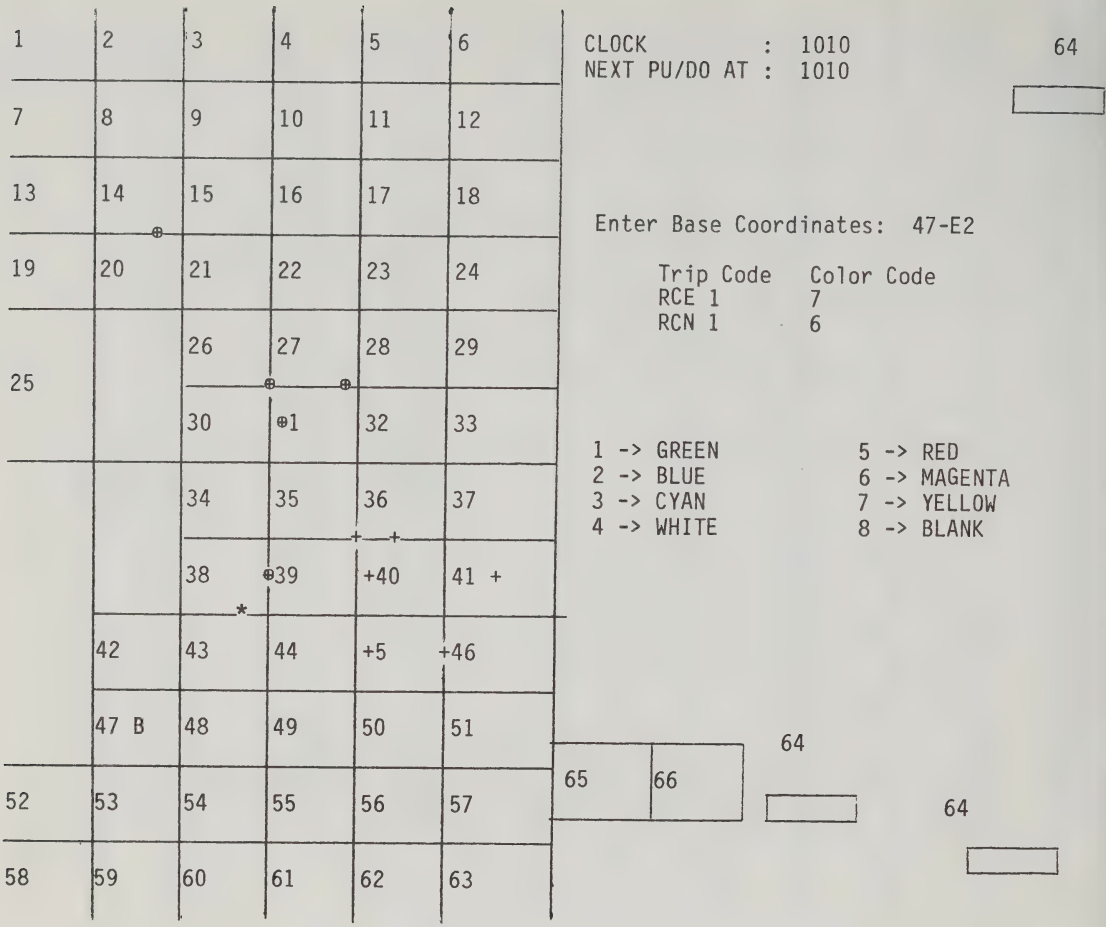
Legend:

OMC	Starting map coordinate
DMC	Stop map coordinate
DIST	Distance covered in miles
NPASS	Number of passengers
PM	Passenger miles
CPM	Cumulative passenger miles
DEADHEAD	Deadhead miles
TRIP	Route designation/identifier

This is a report of a DART route (trip) called CAM. The user can study the route parameters as the van progresses from one destination to the next.



This is the first screen display for the second function. Here the user selects the routes and the colors in which the routes are displayed on the screen.



In this screen display, the user can watch the two routes that he has selected in progress. The two routes are displayed in different colors (indicated here with + and o symbols). The * indicates the current location of the vans and the + signs mark the stops the vans have made on those routes.

A STUDY OF THE OUTDOOR MOBILITY PATTERN OF ELDERLY AND DISABLED PEOPLE USING 4MPH PAVEMENT VEHICLES IN THE UNITED KINGDOM

by Morigue Cornwell

Banstead Place Mobility Centre
Queen Elizabeth's Foundation for the Disabled
Banstead, Surrey

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1. INTRODUCTION

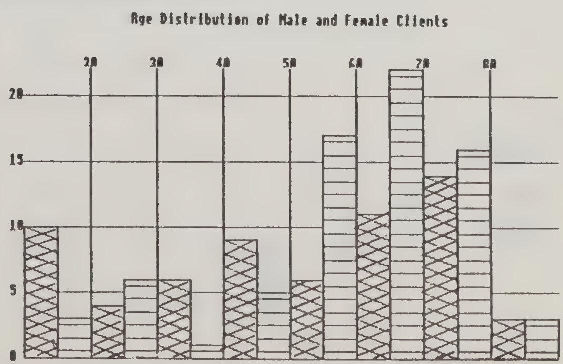
Banstead Place Mobility Centre is part of Queen Elizabeth's Foundation for the Disabled, which is a registered charity operating four units in the United Kingdom. The Mobility Centre was opened in 1982 "to assist disabled people to achieve an optimum level of outdoor mobility which would enrich the quality of their working and social life." One of the services available is an assessment to assist disabled people wishing to purchase a pavement vehicle, to select the one most appropriate to their own needs and life style.

In the United Kingdom, legislation allows "a person suffering from some physical defect" to control a powered vehicle on the highway (pavement/side walk) providing that vehicle is "incapable of exceeding a speed of 4 miles per hour on the level", weighs less than 250 lbs (unladen) and has adequate braking. The user does not require a driving licence nor insurance and there are no minimum visual or medical requirements. It is estimated by the British Association of Wheelchair Distributors that 17,000 of these vehicles are currently in use in the United Kingdom.

A study has been made of the 136 elderly and disabled people seen at Banstead Place Mobility Centre for a 4 m.p.h. pavement vehicle assessment between May 1982 and December 1984.

Many of these people are able to walk short distances but not far enough nor fast enough to give them the same degree of walking mobility as the rest of the population. The function of a correctly chosen pavement vehicle is to restore this very important local mobility which gives elderly and disabled people vital independence.

2. THE ANALYSIS.



Subject Group

There were 63 males (46%) and 73 females (54%).

Throughout this paper ages have been grouped in decades.

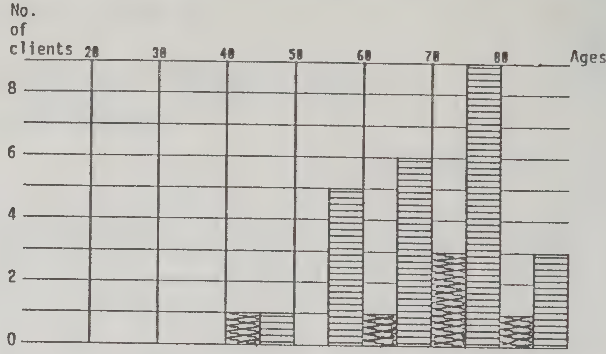
51% of the clients were over 60 years old at the time of assessment.

The four largest disability groups together formed 71% of the total group studied. These were:

Age Distribution of Male and Female Clients

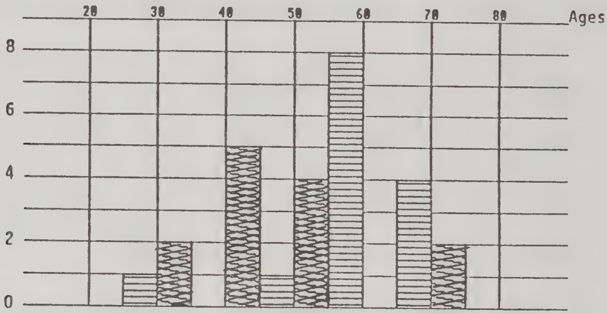
Arthritis (Rheumatoid & degenerative)

Male	6	
Female	24	
Total	30	(22%)



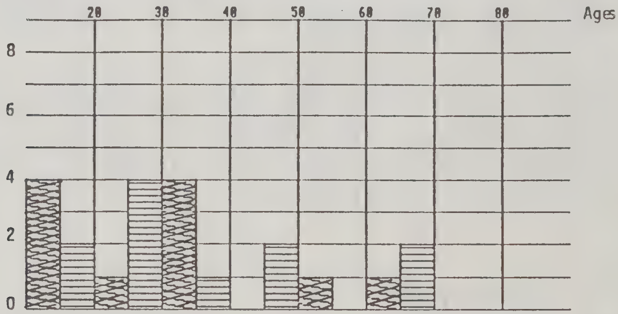
Multiple Sclerosis

Male	13	
Female	14	
Total	27	(20%)



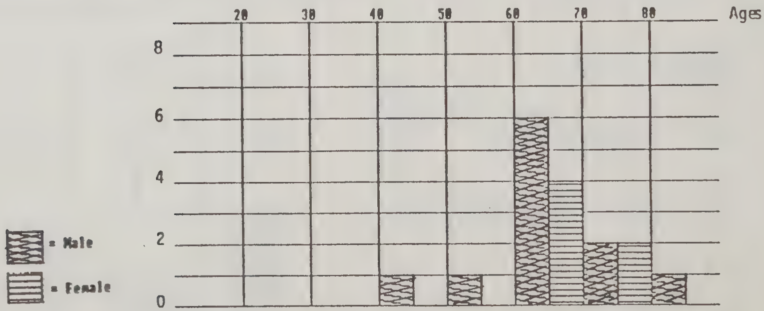
Cerebral Palsy

Male	11	
Female	11	
Total	22	(16%)



'Strokes'

Male	11	
Female	6	
Total	17	(13%)



These tables indicate, as might be expected, that the arthritic group are mainly female and elderly, whilst people with strokes were more frequently male and elderly, but those with Multiple Sclerosis and Cerebral Palsy were of mixed ages and sexes.

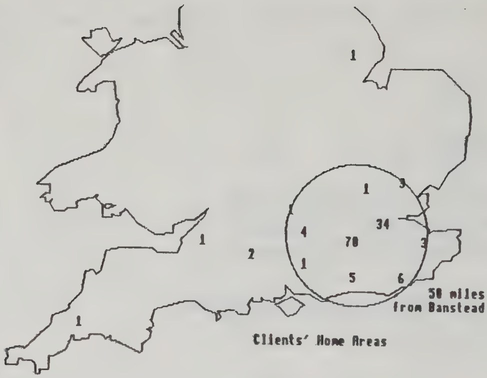
The remaining 29% of the group were made up as follows:

	Male	Female	Total
Myopathies	3	3	6
Amputations (arising from Cardiovascular disease, Diabetes and Malignancy)	3	2	5
Cardiac and Pulmonary diseases	4	1	5
Spina Bifida	4	1	5
Poliomyelitis	1	2	3
Dystrophia Myotonica	1	1	2
Head Injury	2	0	2
Parkinson's Disease	0	2	2
Alcoholism	1	0	1
Arthrogryposis	1	0	1
Diabetes	0	1	1
Elephantiasis	0	1	1
Friedreich's Ataxia	1	0	1
Malignancy	0	1	1
Myositis Ossificans	0	1	1
Polyneuritis	0	1	1
Spinal Injury	1	0	1
Von Recklinghausen's Disease	0	1	1
Plus the four groups from page 2	41	55	96
	63	73	136

Home Areas:

Surrey	70
London	34
Sussex	11
Berkshire	4
Essex	3
Kent	3
Cumbria*	2
Wiltshire	2
Avon	1
Cornwall	1
Hampshire	1
Hertfordshire	1
Lincolnshire	1
Oxfordshire	1
Scotland*	1
	136

* Not shown on map



93% of these clients live within 50 miles of Banstead in the South East of England. It is possible that the climate, geography, density of population and relatively high levels of employment in this area may have influenced the findings.

Method of Follow Up

In order to ascertain the effectiveness of the services offered by Banstead Place Mobility Centre it was decided that all of the 136 clients should be re-contacted by letter one year after their assessment and asked whether they would be willing to complete a questionnaire. Questions were asked concerning their views, one year later, on the usefulness of the visit to Banstead; whether they had purchased a vehicle, if so which one, and whether this had improved their mobility. Details were asked about frequency and destination of journeys and their views on the vehicle.

Response Rate

One month after the first questionnaire had been sent the response rate was recorded as 74%. A second letter was sent to the remaining 26% and, if this failed, a telephone call was made to check the address. Finally 134 responses were received (99%).

Mortality Rate

It was considered particularly important to get as full a response as possible because it has been suggested that many people buying these vehicles die very soon afterwards and that this is the reason for the large and flourishing secondhand market. In this study 8 people (6%) had died within the first year post assessment. Fully completed questionnaires were not received on behalf of these clients and it was not considered appropriate to seek more information than was already offered by letter, telephone message or questionnaire. However it is known that 7 clients had obtained a vehicle

prior to death and, in 4 instances, relatives/friends stated that mobility was improved prior to death. The disabilities and ages of these clients were:

Cerebral Palsy	60
'Stroke'	60
Alcoholism	60
Cerebrovascular Amputee	70
Carcinoma	70
'Stroke'	70
Cardiac failure	80+
'Stroke'	80+

Of these 8 people, prognosis was known to be poor in 5 cases at the time of the assessment.

Completed Questionnaires

Of the 134 people who responded, 16 (12%) were not willing or unable to complete a full questionnaire; their disabilities and ages were:

Cerebral Palsy	60	
Alcoholism	60	all died
Carcinoma	70	
Amputee	70	

Arthrogryposis	20
Multiple Sclerosis	30 & 50
Dystrophia Myotonica	40
'Stroke'	40 & 60
Poliomyelitis	60
Cardiac disease	60
Arthritis	60 & 3 of 70

This resulted in 118 completed questionnaires to analyse.

Clients' views on the assessment and report

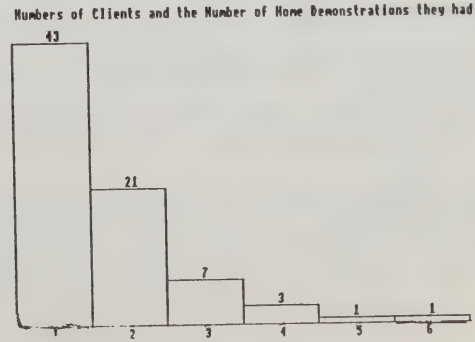
115 (97%) clients stated that they found the assessment helpful and 3 did not.

113 (96%) said that they could understand the report, 2 could not, and 3 did not reply to this question.

Home demonstrations

In the reports it is recommended that clients should have a further demonstration at home and over the intended terrain before purchasing. 76 clients did follow this suggestion and 74 of these clients subsequently purchased a vehicle.

Numbers of Clients and the Number of Home Demonstrations they had



It is, however, particularly concerning that 20 clients went ahead and bought a vehicle without a further trial on their home territory. 10 of this group purchased a secondhand vehicle, usually privately. 2 people were given a vehicle. The other 8 purchased a new vehicle through the manufacturer or retailer apparently without a trial. It is interesting to note that 9 of these 20 people were aged over 70, and clients in this age group not infrequently express concern at inviting a stranger to their home. We, therefore, strongly urge that everyone should have a friend or relative with them during any demonstration. A further 5 people lived in a residential unit, and perhaps did not have the necessary motivation/facilities to organise a home visit.

Those who did not purchase

Of the 118 clients who returned questionnaires, 94 had purchased a vehicle and 24 had not. The reasons given for not purchasing were:

They realised that they would not be safe or that the vehicles would not be appropriate for their home area or personal comfort	9
Insufficient finance	5
Their health had deteriorated	4
Insufficient space to keep a vehicle	3
They are now driving a car	2
He could still just walk to the shops	1

Vehicles which were obtained

50 people (53%) purchased a wheelchair. 15 were the larger, outdoor wheelchairs with front wheel drive. 35 were the indoor/outdoor chairs and these were chosen by those who were totally chairbound or had very restricted walking ability. Wheelchairs offer greater comfort and support together with minimal effort joystick control.

32 people (34%) purchased the outdoor buggies. Many elderly people chose these to extend their walking ability. They offer some weather protection, kerb climbing ability and storage space for shopping.

12 people (13%) purchased the scooter styled vehicles. Manufacturers indicate that this style of vehicle accounts for a large portion of the sales, but many people who came to Banstead Place Mobility Centre were perhaps too disabled to benefit from these. The three wheeled scooters were chosen by those needing short range mobility and vehicles which might be taken in a car boot.

Wheelchairs (53%)		Buggies (34%)		Scooters (13%)	
Dudley Power Plus & Extra Plus	15	Batricar	29	Bec Scoota	5
Meyra 3/422	10	Lion Car	3	Lark	4
Vessa Vitesse II & III	10			Amigo	1
E J Ortopedia/Wayfarer	5			E J Runaround	1
E J Elite	4			Downs Rova	1
Downs Poirier PE46	3				
Bec 40 Horizon	2				
Tunkers Phoenix	1				
	50		32		12

Of these vehicles, 80 (85%) were among those recommended to clients as being worth a further demonstration at the time of the assessment. 14 people (15%) purchased vehicles which had either been discounted at the time of the assessment or which were not available at that time; however, 13 of these people still reported improved mobility and said that they found the assessment helpful. The fourteenth person was a lady with Multiple Sclerosis who did not find the assessment helpful, could not understand the report, purchased a Batricar which was not recommended as she was totally chairbound and she stated that her mobility was not improved.

Method of Purchase

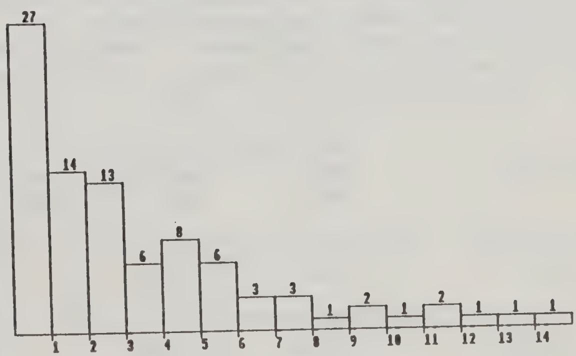
Despite the cost of these vehicles which range from £700 - £3000, 77% of the clients bought new vehicles and many of these people were too old to be in receipt of Mobility Allowance. (1)

New (77%)		Secondhand (23%)	
From manufacturer	42	Private purchase	16
From retailer	29	From retailer	6
Rented from charity	1		
Total	72	Total	22

	69	people paid cash
	16	people received vehicle as a gift (including a secondhand Batricar funded by Social Services)
	7	people used Motability HP scheme
	1	person hire purchased privately
	1	person rented
Total	94	

How soon were the clients mobile following their assessment?

	Nos. of clients	
Within 1 month	27	(29%)
2 months	14	(15%)
3 months	13	(14%)
4 months	6	
5 months	8	(21%)
6 months	6	
7 months	3	
8 months	3	
9 months	1	(13%)
10 months	2	
11 months	1	
12 months	2	
13 months	1	
14 months	1	(3%)
15 months	1	
	(5 no reply)	



Time (months) from Assessment to Mobility for Nos. of Clients Total = 89

It is reassuring to note that 58% of clients were mobile within 3 months of assessment. The 9 clients (10%) who took 9 months or longer to get a vehicle generally were seeking finance. This group could obviously only give limited comments on the vehicle use and performance and ought to be recontacted at a future date.

Instruction at time of delivery

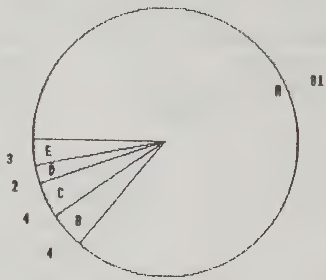
73 (78%) people stated that they were given adequate instruction at the time the vehicle was delivered. 15 (16%) felt they needed more instruction and these vehicles were obtained from:

Manufacturers	7	(6 people did not reply to this question)
Retailers	4	
Private secondhand	2	
Motability HP	1	
Rented	1	
	15	

Improved Mobility

81 people (86%) reported increased mobility (A)
4 people (4%) said it was too soon to know (B)
4 people (4%) said it had not improved ** (C)
2 people (2%) died soon after delivery (D)
3 people (4%) did not reply to this question (E)

** Two of these people stated that the vehicle was too fast; One person said that the joystick was too sensitive; and one said the weather was not good enough.



Frequency of Use

Each person was asked to indicate the length and frequency of their main journeys. They could tick more than one box. Whilst 9 respondents listed occasional journeys over 5 miles at a time, 55 clients' journeys were between 1 and 5 miles and 49 had journeys of less than a mile at a time. Several people restricted the use of their vehicle to warmer weather but 89% of the users took the vehicle out several times a week, and 36% of the users went out at least once a day. This seemed to indicate that these vehicles were indeed being used to replace 'leg power.'

Distance	Once per day or more	Once per week or more	Once per month or more	Less than once per month	TOTALS
Less than 1 mile	20	20	1	8	49
1-5 miles	13	29	12	1	55
5-20 miles	1	1	4	3	9
TOTALS	34	50	17	12	113

Activities for which vehicle is used

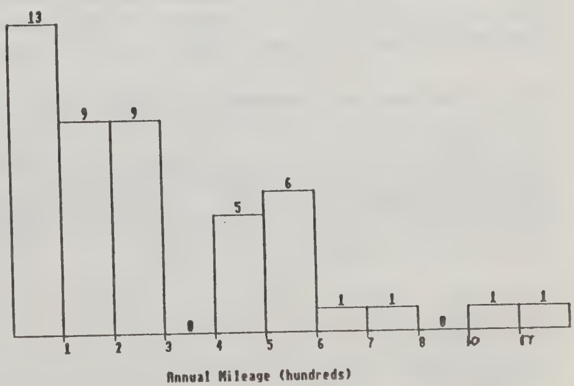
Going to the shops	75	(80%)
Visiting relatives and friends	41	(44%)
Taking inside shops	38	(40%)
Pleasure trips to the countryside	33	(35%)
Social activities	32	(34%)
Visiting doctor or hospital	22	(23%)
Taking on holiday	21	(22%)
Going to disabled person's club	12	(13%)
Use inside the home	11	(12%)
Attending sports activities	9	(10%)
Going to and from work	4	(4%)
Going to church	4	(4%)
Gardening	3	(3%)
Work/day centre	2	(2%)
Walking the dog	2	(2%)
Taking children to school	1	(1%)
Stately Homes	1	(1%)
College of Further Education	1	(1%)
Within residential hospital	1	(1%)

The primary use for these vehicles was to go shopping (80% of users); and it is worth noting that of the 47 vehicles which were small enough to be easily taken inside shops, 38 people reported doing so. However, only 11 of these people needed to use the vehicles within the home.

Annual Mileage

Most people had difficulty answering this question and 48 people (51%) did not reply. (This may be due in part to the design of the questionnaire which therefore has been changed for the current study.) The lowest recorded annual mileage was 10 miles and a further 12 people thought they did less than 100 miles; those who stated that their mobility was not improved were in this group but the others still stated that their mobility was increased. However, it would seem, in some cases, that it might be more economical to pay for a taxi than purchase and maintain a pavement vehicle. The greatest annual mileage recorded was 1,700 miles with a median of 250 miles, which very roughly corresponds with distances walked by similar aged able bodied people outside their home.

0 - 99 miles per annum	13
100 - 199 miles per annum	9
200 - 299 miles per annum	9
300 - 399 miles per annum	0
400 - 499 miles per annum	5
500 - 599 miles per annum	6
600 - 699 miles per annum	1
700 - 799 miles per annum	1
1,000 miles per annum	1
1,700 miles per annum	1
Total number of people	46

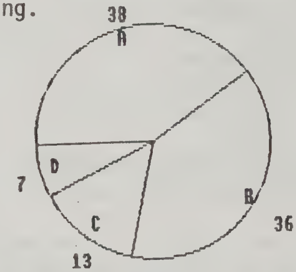


It can be seen that the annual mileage figures do not compare well with the frequency of use chart and the list of activities, possibly because users find it difficulty to estimate annual mileage. An alternative phrasing of the question might be tried for future work (e.g. How many miles do you think you travel in an average week?).

Kerb Climbing

Many urban areas still have insufficient dropped kerbs making kerb-climbing vehicles necessary. Despite the fact that very few of these vehicles offer a comfortable and easy climb and descent of a kerb, it is surprising how many users do carry this out. 77 of the vehicles purchased have an integral kerb climbing ability or have been purchased with kerb climbing attachments and 74 of these vehicles are being used for kerb climbing.

	No. of clients	
Often climbs kerbs	38	(A)
Occasionally climbs kerbs	36	(B)
Never climbs kerbs	13	(C)
No reply	7	(D)



Going out in the dark

In contrast, 61 vehicles have been purchased with integral front and rear lighting, and two people bought lighting as an optional extra, yet only 28 people go out in the dark. This may be due to the age group, or perhaps it is a reflection on 'urban life in the South East' during the 1980s.

Users' views of their vehicles

The clients were asked to give their views on the design and performance of the vehicle, which were of course subjective. Some specific points on the design and location of controls have been made and these are being passed on to the manufacturers. One general complaint was that the vehicles did not offer adequate weather protection (57%); this however must be related to the disability and the climate. The other recurring complaint was that the vehicles did not go far enough or fast enough. This may be partially due to the legislation which requires the vehicle not to exceed 4 m.p.h. on the level and, in practice, this speed is significantly reduced as the vehicle climbs a gradient. (2) It is suspected that the slowing down of the vehicle is misinterpreted by some elderly users as the battery running out of charge.

It is interesting to note that users who stated that they did not have enough range were not necessarily the 'long distance' users. One gentleman claiming to travel 50 miles per annum with a secondhand Batricar stated that he had insufficient range, possibly owing to an ageing battery or poor battery charging technique. 13 people (16%) complaining of insufficient range is a large enough group to cause concern and be worthy of further investigation, also the 14 people (17%) who felt the controls could be improved.

Those who reported difficulty with access complained of obstruction by some footplates and central kerb climbing devices. Some wheelchairs had on/off pressure switches at the top of the front of the control box where clients automatically wanted to hold on to facilitate rising or sitting down.

The questions asked were:

	% of negative responses
Is the vehicle's appearance adequate?	2
Are the running costs satisfactory?	12
Do you find access to the vehicle easy?	15
Does the vehicle have adequate range?	16
Are the controls adequate?	17
Is the vehicle fast enough?	21
Does the vehicle carry sufficient shopping?	24
Does the vehicle offer adequate weather protection?	57

(Not all these questions were answered by everyone, particularly new users)

3. CONCLUSION

It is noted in the overall findings of this study that 97% of the clients stated that they found the assessment helpful, and 86% reported an improvement in their mobility following the purchase of a pavement vehicle.

These figures compare very favourably with a recent study funded by The Nuffield Foundation (3) which shows that the greatest number of Motability purchasers selected the vehicle through brochures and advertisements and 53% of these people were very satisfied whereas, of the very much smaller group who selected by demonstration or a visit to an exhibition, 72% were very satisfied. From this study it certainly appears that the Banstead method of assessment is effective in assisting people to choose a vehicle and that an appropriately selected pavement vehicle can retain or regain safe local independent outdoor mobility for elderly and disabled people having a beneficial effect on their lifestyle.

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(1) Mobility Allowance is granted to disabled people who ar 'unable or virtually unable to walk'. People must apply for Mobility Allowance before their 66th birthday. In 1986 the value of this DHSS Allowance is £1113 per annum tax free.

(2) Disabled People: The Use of Special Vehicles: November 1985: M. Cornwell: unpublished.

(3) A Survey of Users and Non-Users of Motability Services: Wheelchair Users: May 1986: Prof. G. Hoinville: in press.

THE PARTNERSHIP WHEELCHAIR

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The Partnership Wheelchair.

One of the factors which became crucially apparent during the "Year of the Disabled" was the need to examine the requirements of that group of people just outside the existing wheelchair user group, and to see if it were possible to extend the usefulness of wheelchairs, by re-design if required, to cater for this group.

The British Department of Transport accordingly placed an exploratory contract which, whilst requiring existing standards to be adhered to, also allowed free rein to produce a new design concept.

A report and design were duly produced and the ensuing discussion resulted in a very much extended contract to "conceive" the entirely new wheelchair to meet an entirely new set of constraints, which is the subject of this paper.

Ofcourse the new chair had to be lighter, smaller and yet accommodate the same range of people, be as stable as, more comfortable and less expensive to produce than the existing chair.

In addition the chair had to be capable of being folded into packages - two - which themselves were to be small enough to be treated as hand baggage as far as International Airline standards were concerned, neither of which was to weigh more than 12 Kgms.

Probably the most difficult part of the whole exercise was devising quick-release fastening systems for the main, hand and castor wheels which, whilst being easily operable, did not affect the final, folded package sizes which are fixed at 45" for the sum of the three linear dimensions.

In order to make the chair reduce to this package size it is immediately obvious that all wheels must be removed and equally that the main wheels had to be smaller than those of the existing chair which, at 22" dia. and over 1" thick, separately exceeded the allowed figure. At the same time it was envisaged that much improved access could be obtained by making the arm-rests fold down, forming a side transfer bridge as they did so, and this too required a smaller main wheel.

In parallel with this reasoning was the desire to avoid the problems of trapped fingers and dirty hands that go unavoidably with the conventional hand wheels, attached as they usually are to the main wheels; there arose therefore the idea of separate hand-wheels, driving the main wheels by means of toothed belts, and bringing with it the feasibility of alternative drive ratios to suit individual requirements.

Thus it became possible to have at all times, clean hand wheels, ergonomically positioned, easy lateral transfer with an integral bridge, and, with the hand wheels removed, a much narrower wheelchair than standard having, never-the-less, equivalent seating capacity.

To improve access still further, and recognising that wheel-chairs tend to shy away when approached from the fore-quarter, it was decided to incorporate castors with both swivel locks and brakes. The effect of this was twofold - firstly making the chair extremely stable on entry, and secondly satisfying the secondary requirement of making the chair much more directionally stable when negotiating cross cambers, the latter with only the castor swivel locks engaged of course.

The problems that the attendant experiences in negotiating down gradients was considered in conjunction with a requirement for dynamic braking for the occupant, and cable operated braking has been adopted, allied to drum brakes to avoid adjustment problems, for both occupant and attendant. In fact this method of operation for the attendant has led to advantages not forseen in that the chair is very much more manoeuvrable in confined spaces because it may be turned when in motion simply by applying one or the other hand brake - skid-steering in automotive terms. It had already been envisaged that tilting the chair backwards using these brakes - as opposed to standing on a foot-rest - could be advantageous, a point since born out by experience.

Two back rest positions were provided to give various stability conditions according to occupant requirements, and also two inclinations for personal comfort. In the folded down position of course the actual handles had to be capable of rotating through 90° to lower the overall height.

Probably the most interesting, single development on the chair also came about following the requirement for single-handed folding in conjunction with extreme compactness when folded. This was the system of horizontal and vertical cross links whose ultimate simplicity not only allowe the easy folding required, but also provides a large luggage space, easily accessible to the occupant. A natural spin-off of this development was the single, central footrest which avoids problems experienced by all those who walk around wheel-chairs and bark their shins on the exposed metalwork, since when folded away from the occupants foot area it is still central and not round the sides of the chair.

Finally, an oft repeated complaint about standard chairs was that, although the chairs were not all that heavy, they were extraordinarily awkward to handle when folded; moving them in and out of cars being quite hazardous on its own, quite apart from all the difficulties of lifting an occupied chair up and down steps for example. A full range of lifting points was therefore provided, seven in all not counting the spoked castor wheels, all readily accessible to carriers on all four sides of the chair. Thus was the concept of the wheel-chair built up into a working design, culminating in the working models illustrated.

To establish a precise location for the new hand-wheel position an extensive survey was carried out, taking into account published data regarding ergonomically efficient operation of the arms, and by the use of a specially constructed rig with a range of disabled people. This survey established that in fact there was quite a range of acceptable positions and the real difficulty was establishing the optimum.

Throughout the exercise advice was sought from an advisory committee comprising representatives of all facets of the wheel-chair operating world and many other individual sources; all provided help and advice in such liberal quantities as to make life difficult in separating the useful from the merely helpful!

The first mock-up chair to the "new design" was completed in mid 1985 and, as is the way of these things, illustrated rather more the way not to do things than otherwise. The initial concept had provision for separate back-rest and push handles, allowing an adjustable back-rest angle without compromising the push handle position, whilst at the same time allowing for longer projection of the handles in an attempt to ease the transverse camber negotiation problem.

This was clearly not satisfactory and the feature designed out of the working models. It was also apparent that the method of operating the foot-rests was not at all satisfactory, they being very difficult to fold and the area of the foot-rest being too small. Folding was not in any way possible single-handed, and, the machine was depressingly heavy at 74lbs!

However, an enormous amount was learnt as expected when earlier it had been decided to make the mock-up really representative of the design instead of a cardboard model, and many ideas emerged as being satisfactory. For the subsequent working models it was decided to make them as truly representative of a production version as possible, calculated weight savings not really convincing anybody. To do this using plastic mouldings was clearly prohibitively expensive and an alternative, equally feasible and light method of manufacture, suitable for mass production had to be sought.

Accordingly an aluminium honeycomb structure was adopted as being a feasible method whilst at the same time being representative in weight terms. The only "problem" here was the clear possibility that the material would be somewhat stronger than injection moulded plastic but expert advice convinced us that equally strong mouldings could be made. The only difficulties experienced were due to problems of bonding in normal prototype shop conditions.

Many problems arose in spreading attachment loads adequately, and all were overcome, the resulting working model wheelchairs weighing, with all working parts and features called for in the working specification, 43lbs, (a weight subsequently reduced by a further 4 lbs by using light weight castors, specially developed by the manufacturer for the purpose, and in the process taking the total weight below the target of 40lbs; a subsequent finite element analysis of the design revealed no areas where useful gains could be made).

The main constraint on the design was to allow for mass production and thereby take advantage of large quantity production methods in reducing unit costs. Hence every aspect of the design of individual components was developed with this in mind as was the production assembly method, perhaps even more critical from the cost point of view. So, in producing a design where different widths of wheel-chair were required, attention had also to be paid to altering as few components as possible in effecting the width change. Hence the development of a modular design where only the transverse panels and seat material needed to be changed, the side panel assemblies being identical for all widths. Seating material incidentally seems to polarise users as few other items - some greeting the porous material used with delight, others with horror, and so compromise can only be achieved by specifying different materials to suit both requirements.

Subsequent to the completion of the four working models, and in response to specific requests, a new design, developed from the earlier one, has been completed to allow for small scale production and more rugged usage in a commercial environment.

To meet these requirements it is not necessary to be able to detach the main wheels or castors, only the hand wheels remaining easily removable with quick release catches. Aluminium plate has been used as a basis to produce an efficient design which not only meets the existing requirement but also pays due regard to future and alternative design features.

The design and development of this series of wheel chairs has been carried out by Midland Design Partnership, of Priors Marston, Rugby, England with the assistance of Prototype Technology Ltd., of Naseby, Northants, England, who also built the working models and first prototype. The chair, and its derivatives, are manufactured under licence from The British Department of Transport.

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Almac Ltd.,
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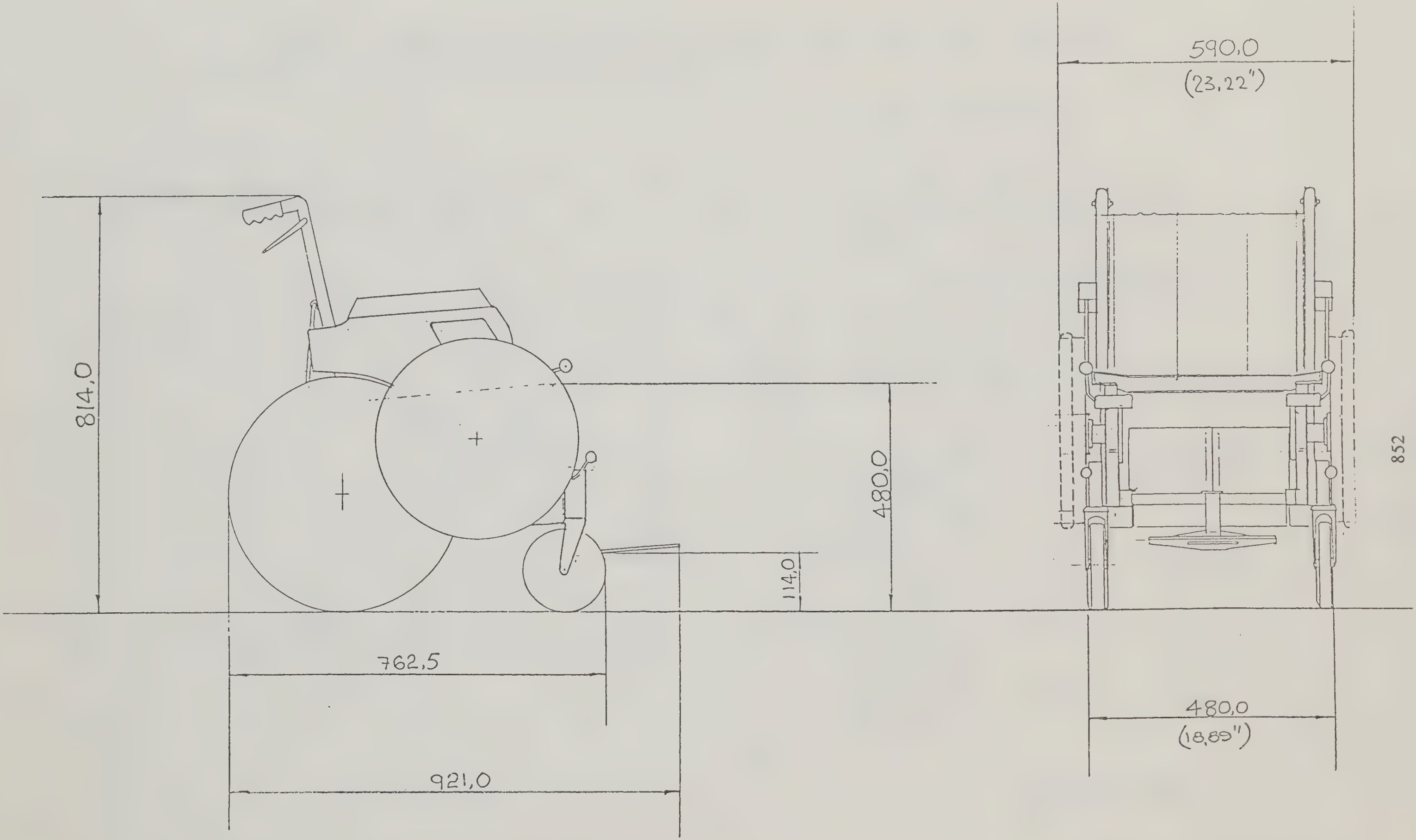
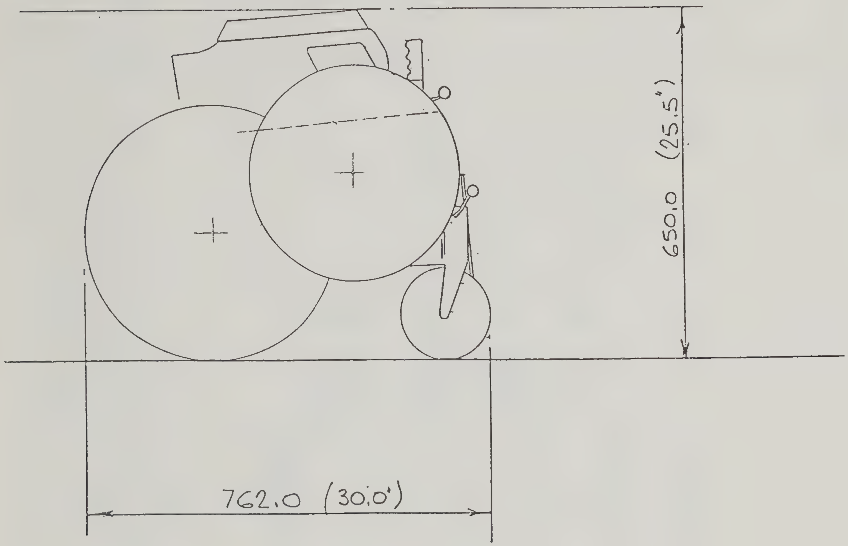


Not to scale

Fig 1. PARTNERSHIP WHEEL-CHAIR: WORKING MODELS.



DIMENSIONAL DATA

mm (ins).

Comparison:-	8L	MDP
CHAIR OPEN:		
Seat width	470 (18·5)	460 (18)
Width OA:		
With Hand--wheels;	610 (24)	590 (23·2)
Without H/W	---	480 (18·9)
CLOSED WIDTH:		
With Hand--wheels;	264 (10·4)	336 (13·3)
Without H/W	---	226 (8·9)

Partnership Chair: folded complete and in two packages:

Item 1.
240 x 305 x 555 = 1100 mm.
9·45 x 12 x 21·8 = 43·3 ins.

Item 2.
457 x 457 x 216 = 1130 mm.
18 x 18 x 8·5 = 44·5 ins.

Drawing not to scale.

Fig 2. PARTNERSHIP WHEEL-CHAIR WORKING MODEL: PARTIALLY COLLAPSED.

The Partnership Wheelchair – 2nd Proposal and Mockup

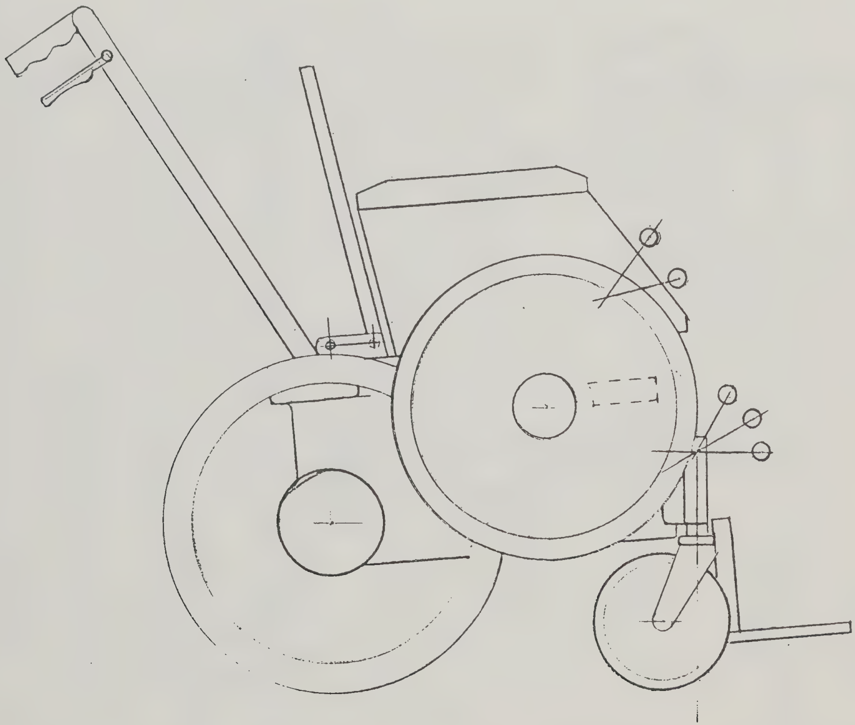


Fig 3

The Partnership Wheelchair - 1st Working Model.

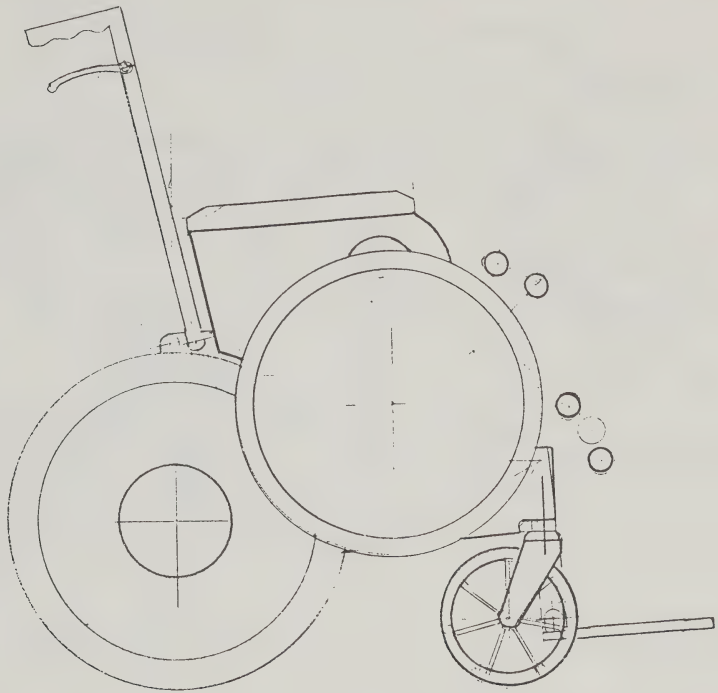


Fig 4.

1) Weight requirement.

The specific user requirement stated in the original contract was that the heaviest assembled group of components should not exceed 12 Kgm. and the total assembled weight should not exceed 18 Kgm

The mockup weighed 33.9 Kgm
The first working model weighed 19.6 Kgm.

2) Weight of major groups.

The weights of the major groups of components on the working models were as follows:

a) Chair, with main frame side pieces and folding linkages seat bottom and back rest, foot rest and armrest, and handlebars, etc.,

7.3 Kgm

b) Drive wheels, with hubs and fixings,

4.7 Kgm.

c) Hand wheels, with hubs and fixings, toothed belt drive and pulleys

4.3 Kgm

d) Front castor wheels, with forks, swivels, locks, brakes and mountings

3.3 Kgm

4) Comparison with Mockup.

The complete weight breakdown of the mockup, as forecast and as achieved is given in table 1.

5) Comment.

The wheel chair can be collapsed into two packages both meeting the aircraft cabin baggage size requirement, and both weighing less than the 12 Kgm required.
The total weight of the first working model exceeded that required but with the new specially made castors, falls inside the limit.

Groupings	Mockup	working model predicted	actual
1) Chair Group			
Main frame, links etc.,	26.91	3.80	9.80
Seat bottom	0.38	0.37	0.40
Backrest	3.37	0.72	0.40
Push handles	1.56	0.75	2.00
Footrest	2.43	0.40	2.00
Group sub-total	38.06	7.8	16.10
2) Drive Wheel Group			
Tyre, rim, disc	7.12	3.72	7.50
Hub, bearings, fixings	1.87	1.80	1.20
Brakes and controls	3.21	1.48	1.75
Group sub-total	12.20	7.00	10.45
3) Hand Wheel Group			
Hand wheels	6.74	3.72	4.00
Hubs and fixings	included in 2)		1.20
Drive pulleys and belts	6.25	3.30	4.25
Group sub-total	12.99	7.02	9.45
4) Front Castor Wheel Group			
Wheel and fork assembly	9.62	9.62	6.50
Brakes, locks and levers	1.00	0.40	0.40
Mountings and pivots	0.78	0.75	0.40
Group sub-total	11.37	10.77	7.30
5) **Grand Total**	74.65	32.59	43.30 lbs
	33.90	14.80	19.60 kgm

CROSSWALK DESIGN
FOR ELDERLY AND DISABLED PEDESTRIANS

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ABSTRACT

CROSSWALK DESIGN FOR ELDERLY AND DISABLED PEDESTRIANS

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and

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This paper describes the findings of an international investigation of pedestrian crosswalk design techniques and traffic signal technology that could assist in reducing the very high rate of accidents involving elderly and handicapped pedestrians. The objective of this investigation was to provide specifications for improved safety in crosswalk systems related to the needs of elderly and handicapped pedestrians. The main conclusion of the investigation was that most of the needs of elderly and handicapped pedestrians can be met by improving urban crosswalk systems for the benefit of all pedestrians.

The paper discusses new and emerging technology that is being utilized by traffic authorities in Canada, the United States and overseas; and potential benefits of a more intensive application of existing and new technology. The paper also reviews related urban design guidelines and traffic safety programs and suggests ways in which professional and trade associations could assist in developing such programs and technology.

The paper includes a description of a student design competition for improved pedestrian crosswalks, sponsored by Transport Canada as an International Youth Year initiative. Student submissions reviewed guidelines, techniques and technology related to urban design which could be incorporated into development and redevelopment projects throughout Canada for the benefit of elderly and disabled pedestrians.

The paper concludes that further improvements in crosswalk design and/or safety for the benefit of the elderly and the handicapped are dependent upon:

- the stimulation of more intensive use of available crosswalk technology;
- the development of new traffic signal technology;
- a demonstration of the state-of-the-art in audible traffic signals;
- the development of pedestrian and motorist safety education resources.

1. BACKGROUND

Current demographics for North America indicate that both numerically and proportionately there are more elderly persons in the population than ever before. There is evidence that, partly because of major advances in the medical sciences, there are also more handicapped persons in the population. The implications of an aging society take on ominous tones when it is considered that the elderly, many of whom are handicapped, have the highest pedestrian accident rate of any population segment.(1) The majority of pedestrian accidents involving the elderly, according to American Automobile Association (AAA) studies, arise at controlled intersections and mid-block crosswalks.(2) Similarly, the United States National Safety Council statistics show that two-thirds of all accidents occurring to persons of age sixty-five or more result from crossing a street, and more than 40 percent occur at intersections.(3) According to the Transport Canada studies, the pedestrian, in general, was at fault (either by behaving incorrectly or not utilizing traffic control devices properly) more than 50 percent of the time in such accidents.(4)

Because the high rate of pedestrian traffic accidents among the elderly is an international phenomenon, several researchers have attempted to find common factors to explain the incidence. These investigations have concluded that the elderly have a disproportionate number of accidents based on exposure rates using such criteria as roads crossed, distance walked and hours spent in walking.(5)

One possible conclusion to be reached from this body of evidence is that there may be factors inherent in the design of pedestrian crosswalks that contribute to the accident frequency. Such a possibility resulted in the sponsorship, in 1984, of a study of "Pedestrian Crosswalk Systems for the Elderly and the Handicapped" by the Transportation Development Centre (TDC) of Transport Canada. Subsequent to this study, in 1985, an International Youth Year student design competition for improved pedestrian crosswalk design was sponsored by TDC. The material following in Sections 2 through 7 has been extracted from portions of the final report on the 1984 study.(6) Section 8 contains a description of the student design competition, which is fully described in a recent TDC report.(7)

2. IMPACT OF E & H PEDESTRIANS ON CROSSWALK DESIGN

Pedestrian movements and vehicular traffic are highly related elements in the transportation system. The elderly and the handicapped, being special kinds of pedestrians, particularly when they occur in large numbers, will affect sidewalk and street capacities. This often leads to special crosswalk designs, grade-separated structures and tunnels inter-connecting major activity centres.

A review of the pedestrian accident statistics (noted previously) reveal that:

- A majority of the accidents occur within close proximity to the dwelling unit.

- A large percent of the accidents (43%) occur at intersections (21% where traffic signals exist).
- Auto-dominant arterial streets present the most serious hazard.

These statistics suggest that pedestrian crosswalks designed to serve residential areas require special attention, particularly where residences are located on arterial streets. To evaluate potential improvements in crosswalk design, it was necessary to define the basic needs of the target group. In reviewing the particular needs of persons with physical dysfunctions, it was found that the following needs were of common concern to elderly and handicapped pedestrians:

- ADEQUATE TIME to cross the roadway.
- BARRIER-FREE design.
- Proper ORIENTATION.
- Accurate INFORMATION.
- Ease of EDUCATION or training in usage (simplicity).

3. ADEQUATE TIME TO CROSS

Typical current design standards for urban streets result in crossing widths ranging from about eighteen (18) metres for local streets and arterials to twenty-six (26) metres for six-lane urban highways. Crossing speeds of able-bodied pedestrians range from about 1.0 metre per second up to about 1.4 metres per second for pedestrians crossing in large groups.(8) Most traffic signals are set for an average crossing speed of about 1.2 metres per second. This speed translates into typical crossing times of from fifteen (15) to twenty-two (22) seconds. Studies of the needs of the elderly in Sweden showed that a walking speed of 0.9 metre per second would accommodate most needs and a speed of 0.6 metre per second would accommodate all but the very slowest.(9) These speeds translate into average crossing times of about thirty (30) seconds.

In the case of non-signalized crosswalks used by the elderly and the handicapped, one possibility is to shorten the pedestrian path so as to shorten the crossing time. In residential areas with low traffic volumes or in pedestrian mall environments, it may be possible to extend the sidewalks that adjoin the crosswalk out to the edge of the parking lane. Another approach used where streets are very wide is to use refuge islands at the mid-point of the crossing.

Limited examples of variations in signal programming were found during a review of current Canadian traffic engineering technology. These were found in Calgary, Alberta, and in Brandon, Manitoba.

In Calgary, in certain cases, pedestrian signal clearance intervals are lengthened to match the time required for elderly or "encumbered" persons to cross the street. When significant numbers of elderly or handicapped persons use the crossing, the timing is extended to accommodate walking speeds of about 0.9 m/second.

In Brandon, the introduction of new solid state traffic signal controllers has allowed the City Engineer to incorporate a four (4) second warning flash

phase within the "DON'T WALK" period. This is to alert pedestrians that there may not be sufficient time to cross the street so they will wait for the next full cycle. Since this variation in the signal programming is not a current standard in Manitoba, approval is being sought from the Manitoba Highway Traffic Board.

One technique, which is being investigated in depth in Great Britain by the Traffic Control and Communications Division of the Department of Transport, is to equip all disabled persons with a small biscuit-sized transponder which would allow equipment on the pedestrian crossing to recognize the presence of a disabled person wishing to cross the road and which would then automatically lengthen the crossing period.(10)

A crosswalk technology known as the "Pelican Crossing" is used at high-volume intersections in Great Britain. This is a three-phase pedestrian-activated crossing system where pedestrians wait for a steady "GREEN MAN" signal before pushing a button to activate a red signal against the traffic. The steady "GREEN MAN" signal turns to a flashing "GREEN MAN" for a sufficient period of time for pedestrians to cross. A period of time is provided when the steady "GREEN MAN" is not displayed to ensure an adequate flow of vehicles through the crosswalk. In effect, the pedestrian is provided with an opportunity to interrupt the signal cycle without impairing the street capacity.(11)

With the exception of the examples above, during the 1984 study the consultants were not able to find any significant studies or applications of altered and/or extended signal programming. As a result, most elderly and handicapped pedestrians are encouraged to wait for the beginning of an initial "WALK" phase before proceeding.

4. BARRIER-FREE DESIGN

It is apparent from the volume of literature available dealing with the removal of barriers that these needs are well understood from the point of view of urban design. The deficiencies are that external design is not generally mandated to any level of detail in building codes, placement of obstacles occurs subsequent to the construction, and maintenance of walkways is often less than that desired by the users.

There are two major areas of concern, mainly to the visually impaired. The first includes hazards due to the placement of such items as sign poles, mail boxes, garbage containers and traffic signal controllers at or near the entrance to the crosswalk. The second area of concern is the construction of wheelchair ramps at the end of the sidewalk immediately prior to the pedestrian crosswalk such that the visually-impaired are able to locate the curb edge.

There are a number of very useful guidelines available on designing barrier-free environments for the elderly and the handicapped. The Australian government recently developed a draft standard on architectural accessibility for disabled persons which includes provisions for external as well as internal building access. This standard, known as "the Australian Standard for Design for Access by Disabled People" was issued in draft form in May 1983. The draft standard was subsequently reviewed by national

associations for the visually impaired through a survey of Australian user groups conducted by the University of Melbourne.(12)

The Ministry of Community and Social Services of the Government of Ontario published a general architectural guidelines manual in 1978.(13) The manual, entitled "Guidelines - Designing for Visually Handicapped Persons", includes references to external planning problems. Guidelines are provided for walkway surfaces, avoiding obstacles, outdoor furniture placement and special treatment of street crossings.

Where a level change is required due to high volumes of pedestrians and space restrictions, the access and egress to the grade-separated crosswalk must be fully accessible in accordance with current building codes. Guidelines for the design of crosswalk structures have been developed by the Federal Highway Administration of the United States Department of Transportation. A manual, entitled "Guidelines for Making Pedestrian Crossing Structures Accessible", was published in August 1984. The guidelines were based on research work carried out at the Georgia Institute of Technology.(14)

Level change often introduces new barriers to the elderly and the handicapped, particularly at urban shopping centres. Specific concerns include:

- Grade-separated crosswalks should continue from the curb edges to the walkways serving the activity centre.
- Crosswalk and walkway identification should be continuous from the property lines to the entrance ways serving the activity centre.
- Accessible pedestrian routes should be identified by signing with the wheelchair symbol.

5. PROPER ORIENTATION

The physical orientation needs of the elderly and, in particular, visually-impaired persons do not appear to be well understood. Current standards for crosswalk design, for example, do not adequately deal with intersections that are not constructed at right angles. Good examples exist, internationally, of the use of tactile clues to orient visually-impaired pedestrians. At present in North America, the aids to orientation used in connection with traffic signals are mainly audible signals.

The principal recommendations of visually-impaired user groups regarding crosswalks include the following:

- The use of colour to differentiate aspects of the environment is by far the most important aid for the visually impaired. Lighting is very important to more than two-thirds of the legally blind.
- Wherever walkways or wheelchair ramps join other walkways, ramps, driveways or parking areas, the transition should be indicated by a texture change.

Substantial experimentation with audible signals has occurred in Australia and in Great Britain. Audible signals for visually-impaired pedestrians are becoming standard in Denmark, Finland, Japan, Norway and Sweden. Most of

these audible signals are equipped with a tone pulse or tactile device which helps to orient pedestrians to the crosswalk.

One example of a very well-accepted system is the audible signals system installed in the City of Huntington Beach, California.(15) This system uses distinct bird-like audible signals to orient the pedestrian in the correct direction and a raised "threshold strip" at ninety degrees to the signal activator to provide a tactile locator.

A unique guidance system for the blind has been tested at the University of New Mexico at Albuquerque, New Mexico. This system, called "Tracks for the Blind", was developed by a professor of the school of architecture, and was installed in the Student Union Building. The system consists of a low-power AM radio transmitter connected to a series of wire antennae placed beneath floor coverings or underground. A low "humming" sound transmitted by the antennae is received by a tiny radio in the blind user's cane. An audible sound or cane vibration allows the cane user to follow the track.(16)

Great Britain has a national policy providing for auxiliary sound signals at uncomplicated signal locations. The Department of the Environment issued a specification in 1968 for audible signals for use with "Pelican Crossings". Currently the Department of Transport is experimenting with new directional audible devices and tactile indicators for use with Pelican Crossings. Experimentation with special orientation devices using male and female voices is currently being carried out in Edinburgh.(17)

6. ACCURATE INFORMATION

Currently most information regarding the status of traffic signals is imparted visually. The red signal is always located at the topmost position or on the left side in the case of a horizontal signal mounting. Similarly, the "DON'T WALK" signal is mounted above the "WALK" signal. This allows some visually-impaired persons to know what the signal status is when the colour or pedestrian graphic symbol is not perceived. The use of shapes other than a circle for the signal heads is not currently being contemplated. The use of audible signals to supplement visual information is increasing slowly. Warrants do not exist for such installations in Canada. The use of other technology such as broadcast signals for those who are both hearing and visually impaired is not apparently being investigated for outdoor applications.

Signal status information is of primary interest to the pedestrian. Standard placement of red, yellow and green signals is used to aid those with colour vision impairments. A great variety of audible signals are being used to aid in alerting visually-impaired pedestrians as to the signal status. There are differences of opinion on the value of audible signals among the users and the advocate agencies for the visually impaired. The Canadian National Institute for the Blind (CNIB) takes the position that there is no substitute for the development of good travel skills by blind and visually-impaired individuals, but recognizes that certain adaptations within the environment, i.e. audible traffic signals, can be of assistance in facilitating safe and effective travel.(18)

7. EDUCATION

There is an apparent need for traffic safety agencies and advocates to undertake to develop appropriate motorist and pedestrian safety education resource programs. Safety education programs for motorists should concentrate on making motorists more aware of the needs and limitations of handicapped pedestrians, particularly those limitations that are not readily visible. Pedestrian safety programs should draw on the experience of child safety programs and the training programs offered by occupational therapists. An example of a good pedestrian safety program is the "Green Cross" pedestrian code developed in Great Britain.(19)

Public agencies developing traffic safety guidelines should consider the following:

- Pedestrian needs are affected by any decreased physical capabilities such as vision, perception, and reaction time.
- Pedestrians may not understand the purpose of the yellow or "DON'T WALK" traffic clearance signal, and as a result may panic and begin running for fear of not making their way safely across an intersection.
- The timing of traffic signals causes anxiety to older pedestrians who may believe that traffic controls are designed for young, energetic persons with rapid walking gaits.
- The "right-turn-on-red" provision is now in common usage. At some locations, this turning movement may be dangerous, especially for the older adult. Some vehicles do not completely stop prior to the turn. The driver's attention is often focused on approaching traffic and away from the pedestrian.
- Motorists making both left and right turns may experience "blind spots" created by the corner support posts of their vehicles. These become larger in inclement weather because windshield wipers do not clear the entire glass area.

8. CANADIAN STUDENT DESIGN COMPETITION FOR PEDESTRIAN CROSSWALKS

The Design Competition was open from November 15, 1985, to March 3, 1986, to senior undergraduate student teams (two or more students) and postgraduate students in colleges and schools of engineering, architecture, urban planning and environmental studies. Their designs were expected to incorporate such items as: crosswalk features and markings, street furniture, transit shelters, signage, transit information displays, and traffic control devices. Current and emerging technology was to be reviewed, with an emphasis on safety and other special needs of disabled and elderly pedestrians.

A two-step submission process was utilized. Students were required to submit project proposals to TDC for an initial approval by November 15, 1985. Following acceptance by TDC, the final submissions to TDC were required by March 3, 1986. A multi-disciplinary team of consultants reviewed the Design Competition proposals and helped the students select eligible projects. The consultants were available throughout the design competition to help students locate technical data and references and to review potential sites for future demonstration projects.

A Design Awards Panel made up of practising engineers, architects and urban planners judged the student entries on the following criteria:

- potential for improvements in overall pedestrian safety;
- potential benefits to the elderly and the handicapped in terms of improved accessibility and safety;
- positive impacts on urban street design and environment;
- improvements in accessibility for the elderly and the disabled;
- positive impacts on automobile traffic and/or transit services;
- potential for implementation;
- benefits to career development and experience;
- overall technical soundness of the proposed system or methodology;
- overall quality of project report and presentation materials.

(a) Student Projects

A total of twelve student projects were submitted from students at seven universities. The universities included:

- Moncton University in Moncton, New Brunswick;
- McGill University in Montreal, Quebec;
- Queen's University in Kingston, Ontario;
- McMaster University in Hamilton, Ontario;
- University of Waterloo in Waterloo, Ontario;
- University of Alberta in Edmonton, Alberta;
- University of British Columbia in Vancouver, British Columbia.

(b) Winning Designs

A total amount of $20,000 in five cash prizes was awarded for the best student designs. Where the winning designs were by two or more students working in a team, the prizes were divided equally among the team members. Individual cheques were provided for all students during April, 1986.

First prize of $7,500 was awarded to Torill Kove and Thomas Leathem from McGill University. Their submission, entitled "Pedestrian Flows and Crosswalk Flaws", provided a comprehensive analysis of and solutions to pedestrian access problems at a busy intersection in downtown Montreal.

Brian Jenkins and William Reynolds of the University of Alberta were awarded the second prize of $5,000 for "How the Turtle Crossed the Road", an innovative pedestrian-activated crosswalk system.

Tied for third place were two teams of students from the University of Waterloo. One prize of $3,000 was awarded to Scott Kapuscinski and Laura Taylor for their compilation of crosswalk design guidelines. The second prize of $3,000 was won by Jason Chu, Eric Robida, Solon So and Veronica Tam for their compendium of urban design standards for elderly and disabled persons.

Fourth prize of $1,500 was awarded to Gaetan Royer of Queen's University for his design of a durable, one-piece wheelchair ramp for pedestrian crosswalks, entitled "Curb and Crosswalk Design".

Dan Dillon and Wayne Roberts of McMaster University won an honourable mention for their submission entitled "Provisions for Elderly and Handicapped Pedestrians in the Manual of Uniform Traffic Control Devices for Canada".

(c) Potential for Implementation

When the Design Competition was first undertaken, it was expected to generate one or more student projects that could be implemented in 1986. This could require the purchase of special equipment and the employment of one or more of the students to implement their award-winning designs.

The potential for implementation of the winning designs was reviewed by the Design Competition team. In the case of guidelines or design manuals, this could entail editing and publishing the student project reports. In the case of potential demonstration projects, a municipal sponsor would likely be required. The following consultant recommendations were therefore based in part on a preliminary assessment of the local interest by municipal traffic officials in the student design. The final selection for a demonstration project by TDC would necessarily depend on the municipal response.

The crosswalk control device developed in the submission entitled "How the Turtle Crossed the Road" was judged to be the best candidate for a demonstration project. Should this pedestrian-activated crosswalk project fail to develop as a demonstration project, the "Curb and Crosswalk Design" submission is a good second choice.

There were three student reports judged to be worth publishing by TDC. Two student projects require only minor editing before they could be published and disseminated to those in related professional practice. These are:

- "A Guideline for the Design of pedestrian Crosswalk Precincts", a University of Waterloo submission by Laura Taylor and Scott Kapuscinski;
- "Provisions for Elderly and Handicapped Pedestrians in the Manual of Uniform Traffic Control Devices for Canada", a McMaster University submission by Dan Dillon and Wayne Roberts that won an "honourable mention".

The student project entitled "Traffic Harmony in Urban Canada", a University of Waterloo submission by Jason Chu, Eric Robida, Solon So and Veronica Tam, should undergo major editing before publication.

The video recording prepared by the McGill students in their project entitled "Pedestrian Flows and Crosswalk Flaws" would be a valuable sensitizing aid for those who are responsible for traffic system design. This tape should be edited and duplicated as a Transport Canada library item. A short descriptive brochure should be prepared on the content of the video and the video itself should be presented at the conference on "Mobility in the Global Village" in Vancouver during July, 1986.

9. CONCLUSIONS

The 1984 investigation found that most of the needs of elderly and handicapped pedestrians can be met by improving the accessibility of urban crosswalk systems for the benefit of all pedestrians. The more specific needs of handicapped pedestrians with particular dysfunctions, such as the visually impaired for example, can be met by applying special technology developed for the purpose. Current deficiencies in crosswalk systems which impact upon the safety of all pedestrians can be overcome by better urban design.

Pedestrian accidents both substantial social and economic costs. The medical and rehabilitative therapy costs for the elderly and the handicapped already consume a large portion of government medicare funding. Pedestrian accident rates also affect insurance, police and municipal administrative costs. The cost to the elderly or handicapped pedestrian in terms of loss of function can be devastating. For some time, their economic wellbeing as well as their physical and mental health can be affected. The evidence suggests that any improvements in traffic signals and systems that would facilitate safer pedestrian activity and therefore reduce accidents would have significant social and economic benefits.

The greatest opportunities for benefits at least cost are likely to accrue from pedestrian walkway and crosswalk system improvements close to the predominant residential areas of elderly and/or handicapped persons. Canadian traffic engineers are making valiant efforts to improve crosswalk safety conditions. Further innovations are constrained by guidelines and standards developed a decade ago. Revised and expanded guidelines are required to stimulate the more intensive use of existing technology and implementation of new technology. The support of professional and trade associations is required for innovation to continue.

The key elements in overcoming deficiencies in Canadian urban crosswalk designs are the following:

- the national, provincial and local building codes;
- the Manual of Uniform Traffic Control Devices for Canada;
- national standards of accessibility;
- national urban design guidelines;
- national research and development organizations;
- the professional community;
- the manufacturers and their trade associations;
- demonstration projects to prove the validity of new designs and technology.

Major improvements in crosswalk design and/or safety for the benefit of the elderly and the handicapped are dependent upon:

- the stimulation of more intensive use of available crosswalk technology;
- the development of new traffic signal technology;
- a demonstration of the state-of-the-art in audible traffic signals;
- the development of pedestrian and motorist safety education resources.

The need for improved crosswalk technology presents a great opportunity to Canadian industry. Technology used internationally to improve the design of audible traffic signals for the visually impaired does not appear to have been tested or implemented yet in Canada. Technology designed to meet the needs of elderly and handicapped pedestrians with dysfunctions other than visual is not apparently being developed in Canada. Examples of technology that could be developed include:

- tactile locators for signal control buttons;
- easily activated control buttons;
- tactile surfaces on sidewalks for orientation and crosswalk boundaries;
- loop detectors for activating message systems;
- programs for traffic signals providing for pedestrian interruption frequencies of less than once per cycle;
- programmable signal control networks that provide for pedestrian-activated signals;
- locator audible signals to guide the visually impaired.

The current demonstration project discussed in Section 8 is expected to contribute to the improvement of the design of signal control activation. Publication of the three student guideline manuals will be a significant contribution to national design standards. Much more work remains to be done. National and international forums such as the current conference can highlight the needs so that the professionals can get on with the job of improving crosswalk safety for the elderly and the handicapped.

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SAFETY OF MOVEMENT ON STAIRS: RECENT RESEARCH FINDINGS, CONSUMER CONCERNS, AND REGULATORY DEVELOPMENTS

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It is an important premise of this paper that a vast majority of people typically considered "elderly" or "disabled" can (and do) use stairs. Permanent, total inability to use stairs occurs with less than one percent of the noninstitutionalized adult population. The goal of this paper is to help improve the quality of stair use for all, including elderly and disabled people.

As the most common form of movement, walking is important as the prime way of getting from an origin to a destination; on longer trips it is an essential part of intermodal transfers. Sometimes walking may also be an important activity within a transportation component such as on a train or on an escalator whether moving or stationary. Stairs are encountered in many of these situations; they are found in transportation terminals and in most buses, trains, and ships; many passenger aircraft have integral stairs for access, egress, and even internal circulation (e.g. DC-9, F-28, 727, and 747 jetliners).

In addition to impeding people with mobility impairments, stairs are often a handicapping element for all users. Stairs are disruptive to all normal circulation in terms of the extra energy expenditure and awkward gait required (1). They are also sites of serious accidents, some of which lead to permanent disabilities. These problems are especially serious for elderly people who are more likely than younger people to be seriously injured, permanently disabled, or killed (2).

ACCIDENT STATISTICS

Walking can be a hazardous activity. According to the National Safety Council's Accident Facts, 1985, in the U.S.A. 8,200 pedestrians were killed in motor-vehicle accidents in 1984 and a further 11,600 people died due to falls in other kinds of accidents (3). Thus the total of 19,800 people killed while walking is over half as high as the total of 38,000 people killed in motor vehicles. This ratio is higher in

other countries with fewer vehicle-miles driven. For example, each year in England & Wales and Sweden, the numbers of fatalities due to falls (estimated at about 4000 and 1000 respectively) are similar to the numbers of fatalities due to motor-vehicle accidents (3-5).

Within the falls category, stairs are the leading site for accidents resulting in serious injury or death. Of all the building-related accidents resulting in hospital-treated injuries, approximately 25 percent occur on stairs. For example, according to the U.S. Consumer Product Safety Commmission's (CPSC) NEISS Data Highlights, stairs are involved in approximately 800,000 of the 2,800,000 building-related injuries treated each year in U.S. hospitals (6). Another comparison, relating stair fall fatalities and total fall fatalities for selected countries, is found in Table 1. These statistics can be compared approximately with motor-vehicle accident fatality rates (per 100,000 population) of 19.8, 16.5, 9.6, 10.6, and 10.6 respectively for the five countries in more recent years, 1982 or 1983.

Table 1.
Approximate Rates (per 100,000 population) in Selected Countries for Fatalities Due to All Falls and Stair Falls

U.S.A. (1975)	5.2	1.9
Canada (1977)	8.0	1.2 +
Sweden (1968)	10.0	1.0
England & Wales (1980)	8.0	1.0
Japan (1976)	2.4	0.5 +

The prominence of stairs as sites for serious falls can be readily understood. The tasks of detecting steps, getting proper footing, and maintaining balance are not straightforward on stairs. A misstep can readily lead to a serious fall especially in descent, the direction of travel for over three-quarters of the serious falls. Also, stairs almost always have unforgiving surfaces to fall against. Given the nature of key stair-use tasks (seeing, stepping, and maintaining balance), it is not surprising that persons with visual and balance disabilities plus fragile bones, due to aging or other causes, are especially vulnerable to stair hazards.

In the U.S.A., compared with the total population, people 65 to 74 years of age are about twice as likely to die due to falls; those 75 and over are twelve times more likely to die due to falls. For those aged 65 and over, falls are the most common cause of accidental death, exceeding motor vehicle accidents (3). For stair accidents, 85 percent of the fatalities occur to people aged 65 or more (2). This age group is over-represented by about 50 percent in the number of serious (hospital-treated) injuries in stair accidents (6).

With problems of weakened bones, among elderly women in particular, any injuries from falls are difficult to treat and very slow to heal. There is likely some under-reporting of the actual toll from falls, especially those suffered by the elderly who often die in nursing homes and hospitals due to secondary causes such as pneumonia.

For those that do not die shortly after a fall, a loss of ability to live independently results in additional costs to individuals, families, and society as a whole. For the U.S., the annual costs of falls (due to wage loss, medical expense, insurance administration, and indirect losses) is in the order of $10,000,000,000. A 1978 estimate of the costs of stair accidents was $2,000,000,000 annually in the U.S.A. - about the same as the costs of new stair construction in the U.S.A. (2). On a minute-by-minute basis in the U.S.A., an average of eight people suffer a temporarily-disabling injury in a stair accident each minute; two of these seek hospital emergency department treatment; and some $5,000 of costs are incurred because of all stair accidents.

Transport Related Accidents

The foregoing discussion of falls has included comparisons with motor-vehicle hazards. Compared with fatalities from falls - even the subset of 4000 that occur annually in U.S. public settings, there are about 2300 fatalities annually in the U.S.A. due to transport accidents (excluding persons at work and motor vehicle accidents but including falls in moving vehicles) (3). (It should be noted that nearly half of the 2300 total is due to "General Aviation" accidents, i.e. not involving the scheduled air services normally used by the public.) To what extent are falls a problem in public transport facilities? This question was addressed in a recent study commissioned by the U.S. Department of Transportation.

In 1985 Fruin, Guha, and Marshall completed a report titled, "Pedestrian falling accidents in transit terminals," for the U.S. Department of Transportation Urban Mass Transit Administration (7). Quoting from the report abstract:

> Based on reports to the Federal Railroad Administration, the U.S. rail transit industry carried 7.25 billion passengers during the period 1976-1980, and these patrons experienced about 10,000 station falls. Analysis of accident reports in one system show alcohol involvement in 29 percent of all falls and 55 percent of male falls when an ambulance was called. Off-peak incident rates were higher, and the P.M. peak is higher than A.M. Most transit falls are due to personal factors. Station falls cost the transit industry an estimated $1.7 million annually in claims settlements. Societal cost for lost time and hospitalization are about the same. High industry standards of design and maintenance result in lower incident rates and settlements than the general experience. Design improvements are warranted to reduce incident rates, severity, and claims.

The report suggests that, based on a more detailed analysis, the industry figure of 10,000 station falls during 1976-1980 could be low; it suggests 30,000 falling incidents during 1976-1980 based on

21 falls per 10 million station exposures. The report deals with human factors and falls, falling accident characteristics, risk and claims management, plus design and operating strategies to reduce falls.

The authors note that, based on a statistical analysis of 1000 pedestrian falling accidents in transit stations, there are about 21 falling accidents and 8 ambulance aided cases for every 10 million station users. Of the 21 rate: 8.3 are on escalators, 4.4 on stairs, and 8.3 on other walking surfaces. Because about 90 percent of the stair falls occurred to people descending stairs, we can conclude that there is an approximately equal reported-fall rate (based on number of station users) for stairs used in descent, escalators, and other walking surfaces. Roughly compared, on a per-flight basis, the overall stair accident rate of 2.8 hospital treatments per 10 million flight uses for all stairs in the U.S.A. (8) is about 50 percent higher than the rate found for transit station stairs in this study.

The authors also note that approximately one out of every four or five victims of a falling accident files a claim for damages against a transit property, alleging negligence. The settlements for such claims (excluding administration costs) are usually lower than general experience, averaging about $1000 to $1500 per claimant. (General experience for falling accidents, based on forty claim settlements in 1982-83, showed a median settlement of over $32,000.) For transit properties, the administration costs for risk and claims management significantly exceed actual cost of claims settlement.

The study provides data on the following factors: traffic analysis, passenger age and sex, facility type, time of day and week, and injury by body location. The analysis by age indicates that people 61 years of age and older are three to four times more likely to have a reported fall than the transit population as a whole (and this disproportionality is most marked with escalator falls). A similar pattern occurs with those under 18 years of age. A related factor, time of accident, indicates that off-peak hours and weekend days (with less-familiar, occasional transit users) have a disproportionately high rate of falls. Regarding sex, considering only those falls where alcohol was not involved, females have a general-fall rate about three times higher than males and a stair-fall rate about five times higher than males. Listed in order of importance, the reported contributing factors in escalator falls (which are believed to occur mostly on boarding and exiting) are loss of balance, alcohol, and tripping; for stairs the main contributing factors are alcohol, tripping, slipping, and loss of balance.

The report concludes with recommendations on design, maintenance, and housekeeping. For stairs the recommendations are comparable with those provided below. For many transit properties, the extra care taken with quality stair design and maintenance appears to be paying off in relatively good safety statistics and low claims settlement costs. Examples include generous tread sizes and moderate riser heights plus handrail shapes and sizes that permit easy grasping. Unfortunately, as noted below, such attention to human factors is lacking in some stairs in Canadian air transportation terminals.

STAIR USE, SAFETY, AND DESIGN GENERALLY

With research, especially over the last two decades, there have been significant improvements in what is known about stair use, safety, and design (2). These topics have also begun to receive overdue attention in regulatory and consumer organizations plus the mass media. Liability of designers, owners, and managers, as well as the ability of such people to obtain liability insurance, are concerns that gain increasing importance.

Key Functional Criteria

A recent two-part article, "What can we do to improve stair safety," was widely published in several U.S. magazines directed to building safety officials and other building industry people (9). Based on relatively extensive stair safety studies (supported by the U.S. Consumer Product Safety Commission, by the National Research Council of Canada and by several overseas organizations) this article described leading stair accident scenarios and recommended careful attention to several key design features of stairs. (Other less accessible publications with comparable detail in recommendations are noted as references 2, 8, 10, 11, and 12.) Three design features are given special prominence:

Steps that can be readily seen.
Treads and risers that are properly sized.
Properly located, graspable handrails.

The importance of the first two of these criteria is underlined when we consider the leading stair accident scenario (from a list of twelve scenarios first published in reference 10 and subsequently included in references 2, 9, and 12). An estimated 19 percent of stair accidents result as adult women in a hurry, elderly people with poor eyesight or those under the influence of alcohol or medication, misjudge tread length when descending. They overstep the nosing and fall, resulting in injuries to limbs.

This leading scenario illustrates the concept of environmentally triggered or architecturally triggered human errors which occur often in stair accidents. Here features of the environment - the illumination, the general setting for the stair, and the tread surface material may tend to hide or distract from the critical perception of the treads' leading edges beyond which the ball of ones foot should not be placed if one wants stable footing. The human error here is overstepping, an error we should not automatically blame simply on carelessness or inattention on the part of the stair user. Examples of faulty stair tread surfaces could include randomly or boldly patterned stone, exposed-aggregate concrete, tiles, and carpet. Illumination and nosing geometry could help or hinder the needed perception of the tread nosings.

Other Environmental Factors

Additional environmental factors, having an indirect role in this stair accident scenario (and other scenarios), have been discussed in

a study by Canadian environmental health authority, Bruce Small (13). For example, even minor deterioration of ones perceptual and motor capabilities, that result from individual susceptibility to contaminants in the air or from food or drug sensitivities, can make stair use extra precarious. For some especially susceptable individuals this can cause difficulties similar to those that come, in widely varying degrees, with advancing age. An example in airline terminals would be the heightened risk of stair mishaps by an individual who is susceptable to petrochemicals such as aircraft exhaust fumes. Other factors are the groggy, disoriented feeling when disembarking from a flight - influenced by reduced oxygen and air quality generally inflight - along with the need to control exactly the leg muscles that may have suffered from hours of limited use inflight. Air terminal design, especially in some Canadian facilities with poor quality stairs, only exacerbates such difficulties and is a source of annoyance and needless hazard. Additional discussion of this topic, presented below, notes also the possible roles of inflight pressurization problems and alcohol consumption.

Slip Resistance of Stair Treads

Of the twelve leading stair accident scenarios only one, accounting for about six percent of the accidents, is due to slipping and this is on wet or icy stairs. Far more accidents - about half of the total - may entail overstepping or misstepping on undersized or inadequately perceived treads (9). The traditional misconception that many stair falls are due to slipping has led, in some cases, to features that have increased, not decreased the risk of falls.

A case in point was the stair tread detail used in a new Western Canadian transit system. Abrasive strips, projecting several millimetres above the adjacent surface of the treads, were installed about 50 mm (2 in.) back from the tread nosings. Here they would do little to prevent a slip occurring at the tread nosings - the most likely place for the vast majority of serious accidents that occur in descent. Furthermore, they presented a serious tripping hazard. It is for this reason that the Life Safety Code, since 1980, has specified that "stair treads shall be uniformly slip resistant and shall be free of projections and lips that could trip stair users" (14). (Note that the wording is "slip resistant," not "nonslip" or "slip proof" - terms that are misleading.)

The three key criteria for stair design (step visibility, step geometry, and handrails) are discussed below beginning wih the matter of step geometry.

DIMENSIONS OF STAIR RISERS AND TREADS

Recent renewed attention (in research and in regulations) to step dimensions has been doubly appropriate. First, there is some consensus among North American stair researchers that having all stairs built with treads at least 280 mm (11 in.) deep and risers not more than 180 mm (7 in.) high could significantly reduce the risk of an accident on such stairs. Secondly, the priority given to such step dimensions recognizes that, of all the aspects of stair con-

struction, the step geometry or stair steepness is often impossible to change, and almost always very expensive to change in existing buildings.

With some adults' shoes measuring 300 mm (12 in.) long (or more in the case of 5 percent of the adult population) it is clear that either there will be an awkward twisting of feet to get the ball of the foot onto something solid or there will be a dangerous degree of overhang of the front part of the foot. This twisting of feet, sometimes the whole body, to achieve footing on undersized treads, is called "crab-like gait." It is one of the ways we have adapted (in part) to badly-sized stairs.

Figure 1 suggests the relative difficulty of getting secure footing with a range of step geometries and a 95th percentile shoe. It should be stressed that the problem of getting adequate footing is not restricted to persons with large feet. The margin for error in stepping down is smaller for larger people but the opportunity for error by everyone increases with the smaller treads. It should also be stressed that the margin for error increases significantly when the step dimensions are nonuniform by more than about 5 mm (0.2 in.).

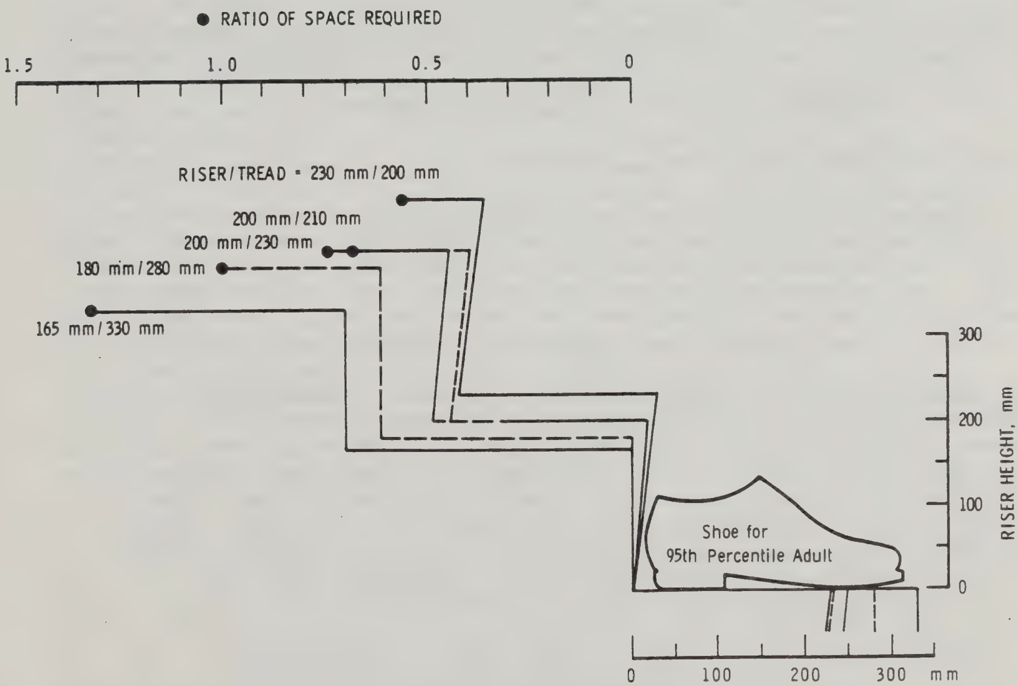

Figure 1.
Stair dimensions relative to size of 95th-percentile adult shoe. Ratio of space required for the stairs (relative to 180 mm by 280 mm riser/tread geometry, the "7-11" stair) is read from the top scale.

Research Background

It was from research (on the geometric possiblities of adequate foot placement, on the rate of missteps with various step sizes, and on other considerations such as comfort and energy expenditure) that the 280 mm (11 in.) minimum tread and maximum 180 mm (7 in.) riser height was recommended. 1974 was an especially important year for such research. John Templer completed his Ph.D. thesis (1) which exmained this topic and, along with colleagues, he summarized his findings and recommendations in an article in Scientific American (15). Along with many other investigators they identified stair descent as the more critical direction - the direction of travel leading to most injuries. Their data actually suggested 312 mm (12.3 in.) as a good minimum tread dimension for safe descent. The 280 mm (11 in.) minimum is a reasonable compromise when a number of factors are considered, including an acceptable degree of overhang of the less critical portion of ones foot (ahead of the ball of the foot).

In all countries where stair safety research has been conducted, there have been recommendations for improved step dimensions and less-steep slopes. Fairly recent North American research (16) confirms the correctness of the recommendations derived from research reported in 1974. Furthermore, the recommendation for moderate stair slopes, with large treads, has been part of traditional guides to stair design even in cultures where people have a smaller stature. For example, a traditional Chinese rule called for the stair tread to be twice as large as the riser height and not less than 305 mm (12 in.), resulting in a pitch or slope of 27 degrees.

Risers and Treads in Transport Facilities

It is noteworthy that in Japan many stairs in railway stations and subway stations have treads satisfying this old rule; their treads are 330 mm (13 in.) deep and their riser heights are 165 mm (6.5 in.). Even more-moderate slopes have been used over the last fifty years in Pennsylvania Railway stations in New York and Philadelphia; they have 360 mm (14 in.) tread depths and 150 mm (6 in.) risers (7).

By stark contrast some stairs used in conjunction with aircraft loading bridges at Canadian airports are inhumanely steep. For example, until mid-1986, everyone boarding or disembarking many aircraft in Ottawa had to cope with stairs with treads only 250 mm (10 in.) deep - measured nosing to riser - and risers 200 mm (8 in.) high, a pitch of 39 degrees. This poor geometry was made even worse by having the risers covered with high-friction indoor-outdoor carpet making it all too easy for ones heels to brush against and catch on the risers in descent. Here we should note that, given Ottawa's five-month snow season, many of the people descending these stairs wore bulky rubber footwear which exacerbated the difficulties of the undersized treads and carpeted risers. Stairs almost as bad as these are still found in Toronto's Pearson Airport Terminal One and are an extra hazard to passengers proceeding downstairs to Immigration and Customs after arriving on international flights. Such stairs say a lot to visitors about the low standard of stair design in Canada, where it is legal to have new stairs as steep as 49 degrees in Canadian homes and up to 41 degrees in public settings.

Riser-Tread Relationship Rules Found in Codes

Some of the traditional rules about step geometry are based on conceptions about comfortable gait or walking behavior, including the matter of stride distance. For example, John Templer's research (1) showed that the best known rule, relating the depth of treads and the height of risers, was developed by Francois Blondel in France over 300 years ago. This rule is usually expressed in the form: twice the riser height plus the tread depth, measured between nosings, should be between 610 mm and 635 mm (24 in. and 25 in.). Observations of people's stride length, plus a theory about the reduction of stride length when walking on stairs, led to the development of this popular rule in 1672. We have to recognize that many people now are somewhat larger than people were in France 315 years ago. Furthermore the rule was meant to be applied only to stairs of moderate pitch and not to stairs as steep as many found today. Finally, the inch that was used in the original rule, calling for twice the riser height plus the tread depth to be about 24 inches, was the pre-revolutionary French inch; it was larger than today's U.S. inch. Thus, although this rule may have been originated with some worthwhile thought about how we walk on stairs, there are reasons for not using it today in an indiscriminate general way.

Such rules permit very steep, precarious stairs as well as the more-desirable moderate-pitch stairs. Secondly they may exclude some moderate-pitch stairs that can be very appropriate for safe stair use. For example, the product rule, requiring that the product of stair riser height in inches and tread depth in inches should be between 70 and 75 (45,000 and 48,500 for dimensions in mm), does not even permit some relatively good stair geometries such those with risers 7 inches (180 mm) high and tread depths of 11 inches (280 mm) or more. (This product rule is used in many Canadian building codes; however revisions are expected because an overdue change was made in 1985 to the national model code, the National Building Code of Canada.)

In the United States, the three model code organizations and the leading producer of life safety standards, the National Fire Protection Association (NFPA), have individually and jointly considered the deletion of traditional relationship rules, such as are discussed above, and adoption of an improved, simpler standard for stair design based on the 7-11 step geometry - so called because of the 7-inch riser maximum and the 11-inch tread minimum (17). Rules making this a standard requirement for new buildings, aside from dwellings, are being adopted or have been adopted - beginning in 1980 with the NFPA Life Safety Code. In Britain a similarly high standard is required of public stairs where there will be intensive use by crowds of people.

PERCEPTUAL ASPECTS OF STAIRS AND THEIR SURROUNDINGS

Recent U.S. research on stair safety had emphasized the importance of perceptual aspects such as the visibility of stair treads and distractions of the environment around the stair (8). A person's awareness of a potential hazard may be as important as the hazard itself.

A general conclusion is that many stair accidents are attributable to environmentally triggered human error. To help reduce such error, the study recommended that there is uniformity in the view seen by the stair user. In more technical terms, there should not be an "orientation edge" or "orientation gradient" (a distracting visual change). Other broad recommendations resulting from the U.S. research included the following:

1. Visibility of tread nosings, handrails and other stair components should be emphasized through design.

2. Lighting and other characteristics should be as homogeneous as possible throughout a stair flight.

3. Visual distractions in the vicinity of stairs should be eliminated.

4. Handrails and lighting should be used to draw the attention of users to stairs, especially those with one or two risers.

Translating these broad recommendations or principles into more specific form, perhaps with quantitative requirements, is not a simple process. This is one reason that building codes and safety standards do not now address these perceptual factors to the extent that may be warranted by their importance in stair accidents.

Stair tread nosings should appear prominently in the whole stair environment. Richly-patterned materials that tend to mask the tread nosings should be avoided. Surface materials should not have a distinct geometric, pictorial, floral, or randomized pattern which is visually more pronounced than the nosings of the treads themselves. Even a minor loss of ones visual acuity would make it very difficult to see separate steps with such surfaces.

Such visual defects of stairs, and accidents that may occur on them, illustrate the following conclusions of research directed by John Archea, a leading U.S. researcher dealing with stair safety (8).

> Although many stair accidents can be triggered by errors or inattention on the part of the user, it is rare to find a stair accident in which the user makes an error that cannot be linked to a distraction, irregularity, or deception built into the surrounding environment of the stairway. While some of the hazards are obvious, many of those which contribute to serious accidents can be quite subtle and may, consequently, escape notice even after an accident has occurred. An accident occurs only under a particular combination of physical and personal circumstances. Although such a combination may occur infrequently, the fact that no accident has occurred on a particular stair should not be taken as evidence that it is hazard-free.

If tread nosings are difficult for descending persons to see (due to surrounding distractions, uncontrollable lighting conditions or surface characteristics of treads) or if step dimensions are nonuniform, there should be a contrasting marking stripe of uniform width (not more than 40 mm or 1.5 in.) uniformly located on the leading horizontal surface (at the nosing) of every tread. Its coefficient of friction should not be less than that of the remainder of the tread on which it is placed and no tripping hazard should be created; that is, it should be flush with the remainder of the tread.

Such marking stripes may be especially important on stairs in transportation facilities where people are unfamiliar with the circulation routes and where there are many unavoidable distractions.

HANDRAILS

Robert Browning likely was not thinking of handrails when, in 1855, he wrote the famous words, "Ah, but a man's reach should exceed his grasp, or what's a heaven for?" His words, along with our everyday experiences using stairs with nonfunctional or nonexistent handrails, might initiate some useful thinking about the provision, location and shape of handrails needed on stairs. Exercising some poetic licence, one might well conclude that in a perfect world (heaven?) all stairs would have handrails that are both reachable and graspable. Unfortunately in our real world of stairs, an appreciation of the simple criteria of reachability and graspability often appears to be beyond the (mental) grasp of those responsible for providing handrails on stairs.

What has research shown us about these handrail criteria - reachability and graspability - that goes beyond what a ordinary person could conclude simply on the basis of casual observation?

Studies in several large Canadian buildings have shown that handrails in some settings are used very extensively and they appear to be beneficial to safety and comfort. The best known study was one done by a team of Canadian researchers and cinematographers in the Commonwealth Stadium in Edmonton during the 1978 Commonwealth Games. In addition to research reports and publications the study produced an evocative documentary film "The Stair Event" which has done a great deal among members of the public and among design professionals to raise awareness and improve understanding regarding stair design, use and safety (17).

Handrail Location

Figure 2 is an anthropometric analysis done by the author showing that, for reachability, handrails should be considerably higher and closer together than is permitted or required by many existing building codes. This analysis of the extent to which 95 percent of the U.S. adult population can reach to the side, suggests that, on stairs used by crowds, handrails should be no more than approximately 1575 mm (62 in.) apart and about 940 mm (37 in.) high. Lower handrails should have their lateral spacing reduced by about 2 mm for every mm that they are lower than 940 mm. Codes have traditionally

permitted much lower handrail heights - as low as 762 mm (30 in.) - and have permitted lateral spacings of as much as 2235 mm (88 in.) - clearly beyond the reach of many people who might be forced by crowd conditions to walk in the middle of such stairs.

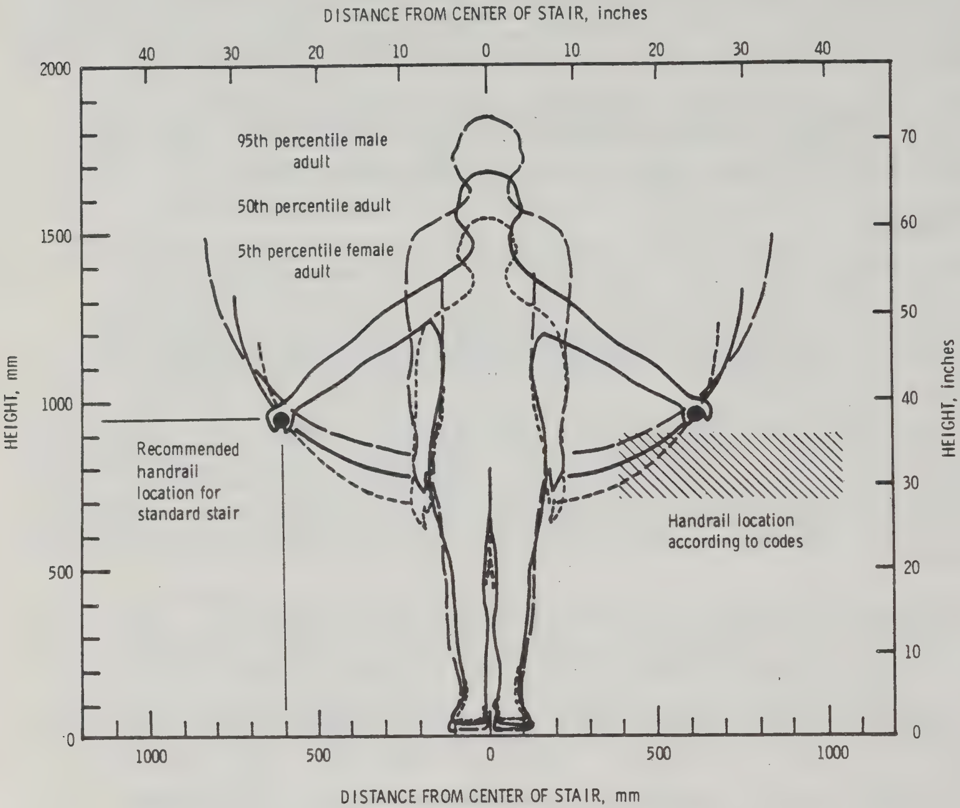

Figure 2.
Ability of persons in the middle of a stair to reach a handrail.

Although the results of this simple analysis were supported by field observations, questions remained as to the usefulness of handrails at various heights. Were people able to achieve a useful force to arrest a fall with the higher handrails suggested by the analysis? Were the low handrails permitted by codes useful? To answer these questions the National Research Council of Canada commissioned experimental studies by West Park Research in Toronto (18, 19). In a laboratory, measurements were made of the forces and moments that could be exerted on a variable-height test handrail by young adults and elderly persons. Studies done with six handrail heights, 813 mm to 1067 mm (32 to 42 in.), and three stair slopes (33, 41 and 49 degrees), confirmed that higher handrails were more useful; the best performance by both population groups occurred with heights between 914 mm and 965 mm (36 in. and 38 in.) at all stair slopes tested.

Moreover, the average preferred handrail height for young and older adults alike was 927 mm (36.5 in.). The best functional dimensions and the average preferred dimensions lie outside the range permitted by many U.S. and Canadian codes and standards but this situation is changing as one U.S. model building code has adopted increased height requirements based on the Canadian research; other U.S. organizations are considering similar changes.

Handrail Graspability

The matter of handrail shape and size was examined in another West Park Research study funded by NRC Canada. The researchers examined the influence of handrail size, shape, surface texture, and compliance. They confirmed that the best handrail sections have a round shape with a diameter of 32 mm to 45 mm (1.25 in. to 1.75 in.), however some other sections provide comparable graspability if perimeter dimensions and maximum dimensions are within some limits (20). This work, like the earlier study of handrail height, was based on the functional performance of younger and older adults (those aged 65 years of age and older).

As with some other aspects of handrail design this matter of appropriate size and shape for graspability is also readily understood by ordinary stair users. We have to be able to lock our fingers around the handrail. The best shape for this, assuming that a person's hand may have to grab the handrail from various directions, is a round one. Such a shape, with a diameter of about 38 mm (1.5 in.) also happens to be one of the least expensive in either wood or metal.

There is a graspability problem with some of the handrail shapes often shown as acceptable in design standards for buildings that are accessible to persons with disabilities (21, 22). As a concession to designers who insist that a handrail must have massive depth - based on some aesthetic (mis)conception - these standards permit sections where there is only a groove or indented region on one or both sides of the rail to allow some of the fingers to curl underneath to a limited extent. In addition to being aesthetically questionable such sections offer poor graspability even when ones hand approaches from an ideal angle and even when there is considerable grip strength in the hand. Anyone with reduced grip capability or anyone forced - in a fall, for example - to grab from the side is out of luck; there is no way to get ones thumb, and often other fingers, around anything to develop a sufficient force to regain balance and arrest a fall.

Designers all too often give us handrails that are not only quite disfunctional but also very expensive. They perhaps feel that the scale of the handrail must match the scale of the stair or its setting; thus we see large metal and wood handrail sections that are better structural columns or beams than handrails. Such designer insensitivity to, or ignorance of basic human factors has led this author to suggest what may be the ultimate answer - "The Acid Test for Handrail Graspability." It starts with the reasonable assumption that ordinary people should be able to grasp a handrail and support about one-half of their body weight (not unlike what might be required when arresting a fall down a stair). Secondly, such

an action might be undertaken with some extra urgency or feeling of desperation. Thus the test. The designer of the handrail is required to hang from two sections of his proposed handrail, one for each hand grasping in the usual manner, and to maintain his grasp while hanging over a vat of acid. We would very quickly have designers anxious to provide reasonable, functional, cost-effective handrails if this were the graspability criterion to satisfy.

But what about designers who, despite the research, the potential lawsuits and the proposed "Acid Test," are still not sensitive to the functional purpose of handrails? Perhaps a greater public protest from ordinary stair users is warranted. Moreover, based on recent research on handrail height, it is reasonable to recommend, by way of retrofit, that a proper functional handrail should be installed on top of the oversized, nonfunctional railings provided by such designers.

Other Handrail Details

Two other handrail details might be noted here. In some cases, standards for these were originally introduced to help improve stair use by disabled persons; however, they do benefit all stair users. Horizontal extensions of handrails help people to grasp a handrail before they must take the critical first steps, especially in the downward direction. The height of the horizontal portion of the handrail should be the same as it is above the stair nosings.

A related detail is to maintain handrail continuity between flights, especially at the inner turn of stairs. Generally there should be continuity in the graspability of handrails; i.e. there should be no vertical portions to adjust for different heights. Fortunately this continuity criterion is easier to satisfy with properly sized handrail sections than it is with the disfunctional, larger sections.

CASES OF GOOD AND BAD STAIR DESIGN IN CANADIAN TRANSPORT FACILITIES

The following examples are not the result of a formal or comprehensive survey of Canadian transportation facilities. They are merely what has been seen, in the course of extensive travel within Canada, compared with facilities encountered during much travel in the U.S.A. and overseas. No attempt has been made to relate what is reported here with any Canadian Government standards other than what is contained in the National Building Code of Canada, a comparatively weak document in terms of stair design.

With the inadequate rules it is not surprising that many Canadian stairs have treads that are difficult to see and too small for good footing - combined with risers that are too high. Moreover such stairs often have ungraspable or otherwise disfunctional handrails. Compared to what is known technically (or even what is in other important standards), none of the these criteria are adequately covered in the Canadian building codes. In a few notable cases, where stairs were designed to a better standard, this occurred because the owner, designer, or regulatory official decided to set aside the Canadian rules for more realistic ones from somewhere else.

Terminal Design

A fairly successful approach to stair design is found in the mid 1970's construction of the GO-Transit station at Toronto's Union Station. Tread and riser geometry plus handrail size, shape, and lateral spacing all illustrate designer awareness of, and sensitivity to good stair design technology. Also in Toronto, the standard metal handrail section used in Toronto Transit Commission subway stations suggests that there is a concern for handrail graspability.

The example has already been noted of Ottawa Airport's recently retired bad stairs, serving the aircraft loading bridges. However, the recent opening of the first section of the rennovated terminal has some glaring examples of almost everything being done wrong with stairs. Due to an unfortunate choice of floor elevations (to match some existing construction) passengers take an escalator or elevator to a small area used for security clearance and then are immediately confronted with a very wide, six-riser stair to get down to the departure lounge level. This violates a principle of design applying especially to transport facilities; there should not be elevation changes - particularly served by stairs - unless they absolutely necessary. Even if one accepts the debatable argument that an elevation change here is completely unavoidable, one might at least count on the resulting stair being built to the best standard. Such is not the case here as all three of the key criteria for stairs are violated.

First of all, immediately as a person leaves the confusion and bustle of the security-screening process, then faces a panorama of departure gates with large windows providing additional distracting views and glare, there are five stair treads that are difficult to see because of the choice of material and ineffective nosing marking.

Secondly, the treads are designed only to a minimum standard - with 280 mm (11-in.) tread depths (discussed above) - a tread depth standard that should be exceeded by about 50 mm (2 in.) in transportation facilities such as this one. The riser height of 171 mm (6.75 in.) would have been better if somewhat smaller (even though it is a great improvement over the 200 mm, 8-in., high risers on stairs in the old terminal).

The final insults to passengers, finding themselves on such stairs, are the handrails which are far apart and difficult to grasp; the standard handrail diameter is 64 mm (2.5 in.) - 66 percent larger than it should be for optimum graspability. Similar stair problems are encountered by deplanning passengers who have to ascend six steps to get through a security barrier on their way to a down-direction escalator and their luggage. However clearly the safety problems are greatest for passengers trying to get to their flights; they face six unexpected steps in descent, the more dangerous direction of travel.

Other Canadian air terminals, built over the last twenty years, have stairs illustrating fewer of these severe defects; however they still pose unecessary hazards. Terrazzo stair treads, used in some Western Canadian airports and encountered in long flights used by deplanning

passengers, pose serious visibility problems, especially for people with visual impairments. Walls seen by people descending some of the public stairs in Edmonton's Municipal Airport are decorated with angled parallel concrete fins which add a distracting element to the task of seeing the easily-confused quarry-tile treads. The "handrails" here consist of deep, ungraspable sections. Some other Western Canadian airports (e.g. Saskatoon and Winnipeg) also have ungraspable "handrails" made of deep, wood sections. Some public stairs in Mirabel Airport, near Montreal, have their oversized, ungraspable railings made of metal.

Many of these stairs appear to illustrate the perverted architectural principle that the more money there is to spend on a stair, the worse it will be. This is most often found in handrail design, however examples occur also with expensive concrete wall surface treatments that are, first, visually distracting and, second, especially "unforgiving" if one brushes up against them (as in Edmonton's Municipal Airport). Incidentally, the concept of "unforgiving stairs," and, alternatively, stair surfaces designed to be more "forgiving" to people in a fall, is currently the subject of research by U.S. stair researcher John Templer with funding from the U.S. National Science Foundation. (23).

Stairs on Trains

An actual fall on a stair within a VIA Rail observation car illustrates the special problems that are faced by some elderly persons who are not able to perceive adequately the presence of stairs. Witnessed in December 1981 by the author, the case involved a 66-year old woman walking along the narrow corridor below the upper-level dome of the observation car at the rear of a VIA Rail passenger train. Partly because of the glare from snow-covered scenary viewed through windows in the corridor wall, she failed to see the two risers she would have to descend to carry on along the corridor. Given the distracting view and relatively bright conditions, she also failed to notice the overhead sign warning of the steps. She fell forward a total distance of about two metres landing on the corridor floor at the base of the two steps. Fortunately, because of the narrowness of the corridor and the high-friction, resilient wall covering on one side, some of the energy of her fall was absorbed at the wall rather than on final impact with the hard floor. Shaken up and with a minor contusion on one leg (where it hit a step nosing), she was later interviewed by the author to complement his unusually detailed observations of the complete fall - all of this much to the discomfort of on-board VIA Rail staff who declared (not-surprisingly) that it was the first accident of this type in their 25 years on the train. Apparently the woman had not suffered a serious fall previously but, because of medication prescribed for her by her doctor, she may have had some perceptual problems at the time of this fall.

Physiological Difficulties

Here it is worth repeating the concern expressed above about the debilitated state of some passengers disembarking from jet airliners and the poor condition of stairs they may have to descend at the

terminal. We should not ignore the difficulties faced by passengers who may have balance problems either because of inner ear congestion, due to changes in aircraft cabin pressures or because of medication (such as decongestants) taken to help overcome the pressurization problems.

Also it is worth noting that, particularly with the free alcohol beverages provided on many flights, some passengers have consumed more alcohol inflight than they would normally drink. Reduced oxygen levels inflight may increase the disabling effect which is not noticed until the person gets up from his or her seat. The major influence of alcohol, pointed out in the UMTA-sponsored study of falling accidents in transit terminals (7), should be a cause of concern for airlines and transportation authorities alike. They share responsibility for ensuing falls on terminal stairs, especially where those stairs violate basic principles of stair design.

Here it is useful to repeat part of the quotation from the final report on the extensive stair research program carried out in the U.S.A. in the 1970's (8).

> Although many stair accidents can be triggered by errors or inattention on the part of the user, it is rare to find a stair accident in which the user makes an error that cannot be linked to a distraction, irregularity, or deception built into the surrounding environment of the stairway. . . An accident occurs only under a particular combination of physical and personal circumstances. Although such a combination may occur infrequently, the fact that no accident has occurred on a particular stair should not be taken as evidence that it is hazard-free.

The questionable state of stair design in some Canadian airports suggests that there is neither an official concern for the capabilities of people using those facilities nor much technical effort being devoted to examining the use of such stairs, including accidents and minor incidents. Compared with what is devoted to investigation, basic research, and safety development for aircraft crash prevention, there is almost nothing spent on stair safety in transportation systems or anywhere else for that matter. For example, apparently for every life lost due to air crashes there is something in the order of $100,000 spent by U.S. and Canadian government agencies to investigate the accidents. By contrast, U.S. and Canadian agencies spend almost nothing on stair accident investigation and they devote only about $100,000 annually to stair safety research (in the U.S.A. and Canada combined). If we consider that the $100,000 total must also cover the problem of stair-related injuries, we note that this amounts to a research expenditure of about 11 cents for each hospital-treated injury.

DEVELOPMENTS AFFECTING STAIR SAFETY

Before turning to some developments we might consider one important difference between air crashes and stair falls; air crashes result in

news headlines while stair falls rarely get public attention. Some exceptions were widely-seen television clips of U.S. Presidents Ford and Reagan stumbling when using stairs while boarding or disembarking from their aircraft. But even such widely-publicized falls do not lead to any movement to improve stair safety. Thus, even the very modest pattern of technical developments described below, may be all we can expect for stair safety.

Looking beyond Canada, some other countries have made important progress improving knowledge of stair hazards and their control. There has also been an effort to upgrade the minimum requirements for stair design and construction. The biggest recent developments have taken place in the U.S.A. as the U.S. research of the last decade and Canadian studies of the last two decades have led to major improvements in the circulation design requirements and standards set out in the three major model building codes and the NFPA Life Safety Code (24). Some recent and current adoptions of better standards for riser-tread geometry and handrails have already been noted above. Given the apparent backwardness illustrated above, it is ironic that, on fronts other than the National Building Code of Canada and transportation terminal design, Canada has been relatively active in the stair safety field. Its laboratory and field studies on handrails are second to none. Most of the major meetings of international researchers, dealing with stair safety, were organized with Canadian resources. Its national consumer organization, the Consumers' Association of Canada, devoted some organizational and publication attention to the problem in 1984 (12). One of Canada's television networks drew attention to the problem as part of a popular prime time program (CTV's "Live It Up") in 1984 and 1985. The NHK television network in Japan went even further in 1985 with a half-hour, prime-time program on stair falls and the elderly.

The largest factor influencing stair safety may ultimately be liability actions. So far, only a tiny portion of the (conservatively estmated) two-billion dollar annual cost of stair accidents comes from liability suits. With legal and expert witness fees totalling thousands of dollars per day of court action on a single case, there is much incentive for more action on this front. The growing availability of technical information, such as contained in or referenced in this paper, provides additional incentive as well as a basis for detailed consideration by the courts. Facility designers and operators cannot effectively argue that it is sufficient for them to provide stairs the way they have always done. Nor is it sufficient for them to argue that the stairs were built to minimum code requirements, especially in buildings frequented by the public and particularly if there are contributing factors such as alcohol service. Designing only to minimum standards is a necessary but not a sufficient condition for avoiding liability.

CONCLUDING REMARKS

As noted at the beginning of this paper, the vast majority of people typically considered "elderly" or "disabled" can walk independently; they can use stairs and they do use stairs! There has been much technical information presented or referenced here that, if applied to

transportation facilities, could help to improve quallity and safety of transport for these people. Even more important, in terms of the total population, attention to human factors in stair design can help to reduce the "handicapping" element in stair use as we know it.

Certainly, in terms of both stair safety and enhanced mobility for all, our world would be a better place if alternatives to stairs were always readily available. However this goal is far more difficult to attain than are the complementary goals of convenient circulation route alternatives for those people who really need them and humanely designed stairs for the vast majority of people who, for reasons of efficiency, etc., choose to use them. This latter group will often include elderly persons who, for easily understood reasons, sometimes prefer to use of stairs rather than ramps or escalators.

This paper has been deliberately focused on only several key aspects of stair design that relate to fundamental problems in stair use faced by all users - perceiving the stairs, getting adequate footing, and having a handhold for guidance, balance and arresting falls. Some specialized topics, such as tactile warnings at approaches to stairs (for some people with visual impairments) have not been covered here but are being addressed in current research (at the Georgia Institute of Technology for example). Also not covered are methods for assisting people with severe mobility disabilities on stairs, including the carrying of wheelchairs. This topic, along with other techniques for assisting a wide range of disabled people in building emergencies, is addressed in a summary of a report prepared for NRC Canada by Byron Johnson in 1983 (25). The more basic approach taken in this paper is felt to be more useful than would be an approach addressing some narrow issues, especially as this is apparently the only paper focusing on stair use at this Fourth International Conference on Mobility and Transport for Elderly and Disabled Persons.

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ACCESSIBILITY IN TRANSPORTATION FOR DEAF AND HARD OF HEARING PEOPLE

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ACCESSIBILITY IN TRANSPORTATION FOR DEAF AND HARD OF HEARING PEOPLE

Most people are suprised to learn that hearing impairment is the largest handicap in North America.In Canada, the number of hearing impaired people exceeds 2,266,000, approximately 9.2% of the population.[1] This figure can be divided to represent two groups of hearing impairment: profoundly deaf people who can not hear and understand speech through the ear alone; and,hard of hearing people whose sense of hearing is defective in one or both ears, but who can utilize hearing with or without the use of a hearing aid to understand speech. The profoundly deaf population is estimated at 280,000 and there are approximately 1,980,000 hard of hearing individuals in Canada at the present time.

Causes of hearing loss include medical problems, noise, accidents and the process of aging. In fact, hearing loss is most prevalent among the elderly, a population which will triple within the next 25 years.

Thirty to sixty percent of the elderly population, those over the age of 60, experience some type of hearing loss. If the ability to hear decreases as age increases and, the elderly population is expected to increase significantly over the next quarter century; then it is safe to assume the hearing impaired population will increase significantly in size.

"Much of human interaction is based on the assumption that people can hear and speak- telephones, radio, television, intercom systems and loud speakers. Warning signals are often buzzers and alarms. Time is structured by bells and whistles. Hearing and speaking are seen as going together naturally. Hearing people often infer that because one can speak one can hear well; therefore those who cannot hear may be viewed as not being able to speak. These assumptions lead hearing people to overlook the very real limitations in the hearing abilities of deaf people."[2]

The negative effects of hearing impairment to a person are staggering. Marshall McLuhan expressed the problem of deafness most eloquently when he said, " Deafness is surely the most tragic handicap in a world that lives by communication."

Communication is one of the most important day-to-day activities known to man. It is a two-way process between the sender and receiver. However, there is oftentimes reduced ability to communicate effectively when one person has a hearing loss because the person with some degree of hearing loss has difficulty understanding the spoken message and the person with "normal" hearing may have difficulty understanding a deaf person.

To add to this dilemma, hearing impaired people are not always immediately recognizable because their hearing loss is almost entirely invisible to the average person. While we may notice the wheelchair of a paraplegic individual's wheelchair or a blind person's white cane, there are few noticeable indicators that might suggest a person has a hearing loss.

Take a moment and think about how difficult it would be to try to communicate effectively without your hearing; the confusion and lonliness that you would encounter if you could not properly hear what your family members were saying; the frustration of being denied access to public finctions that hearing people take for granted.

The deaf and hard of hearing person is unable to take full advantage of any communication opportunities. Whether a person is deaf, with no useful hearing at all, or hard of hearing and able to hear with difficulty using a hearing aid, he or she will have problems communicating in their local environment. As well, the individual with a hearing loss will be unable to hear communications systems such as television and radio properly.

Consider the following steps involved in various stages of a trip and some of the obstacles that would likely be encountered by a deaf or hard of hearing individual if no special assistance is made available.

1. Planning- obtaining information about destination, cost, how to get there, etc.

-involves verbal communication with a travel consultant

Obstacles- a) to the deaf person- The telephone. A deaf person is unable to use a telephone properly without a special machine to aid communication.

b) to the hard of hearing individual - The telephone. In most cases telephone use is limited because of inability to clearly understand the spoken message.

Therefore, in the majority of cases, a personal interview would be required.

Obstacles-a) to deaf and hard of hearing people - Communication. Speech and language barriers hinder the ability to fully communicate and understand all that is said so there is high risk of confusion and faulty perceptions re: information.

Throughout any trip the hearing impaired person will encounter situations that require verbal communication with other people such as airline personnel, custom officers, hotel personnel, bank tellers,etc. All these situations will create similar difficulties for deaf and hard of hearing individauls.

2. Transportation- (throughout the entire trip) - involves travelling to the terminal, taking public transportation during the trip and returning home
- involves verbal communication with a variety of individuals such as cab drivers, bus drivers, people on the street (asking for directions) etc.

Obstacles-a) to the deaf person - and hard of hearing individual Communication difficulties can result in misinterpretation of information.

Example: In a cab the passenger usually sits in the back seat and the driver is in the front seat. A hearing impaired person usually relies on many visual cues such as natural gestures, eye movements, lipreading,good lighting etc., to assist proper understanding of the spoken message. None of these cues are available when you are attempting to talk to a person whose back is facing you. Also many deaf and hard of hearing people demonstrate some form of altered speech pattern as a result of there hearing loss and the driver of the cab may have difficulty understanding what the hearing impaired passenger is saying.

3. Announcements over P.A. systems
   - involves listening for pertinent information such as departure and arrival times, gate numbers, emergency messages etc.
   - involves listening carefully to messages transmitted throughout the terminal.

Obstacles-	a) to the deaf person	Can't hear the message
	b) to the hard of hearing individual	Messages from sound systems are often distorted and unclear. Reverberation in large terminals adds to the distortion

4. Hotel- requires registration, telephone messages, wake-up calls and messages, room service, possible emergencies etc.
   - involves communication with a variety of hotel staff members, communication over the phone etc.

Obstacles- to hearing impaired people
- a) verbal communication with hotel personnel
- b) telephone communication
- c) inability to hear warning signals if an emergency should arise
- d) restricted television use

These situations represent only some of the difficulties encountered daily by deaf and hard of hearing people.

Until recently, few public institutions were accessible to hearing impaired people. However, technological advances have resulted in the development of special devices which allow the deaf or hard of hearing individual to function more effectively in a variety of crowded and/or noisy places, such as conference centres, places of worship, hotels, airports and tour buses. Special devices have been developed in the past few years which help to improve the quality of life for hearing impaired people. Doors can be opened to accessibility, productivity and participation.

For example, Air Canada and Via Rail have installed 800-line T.D.D.s (Telephones for the Deaf) so that deaf people can get their own info-mation and make their own reservations. Transportation centres are installing volume control telephones for hard of hearing people. These examples represent a good start. However, there is more to be done to make travel easier and more enjoyable for hearing impaired individuals.

Listed below are several useful recommendations that should always be considered when making any public place accessible to deaf and hard of hearing people.

1. Volume Controls and Compatible Telephones:

Volume controls for the handset of the telephone and special RDA receivers that will make the phone work better for people who wear hearing aids with a 'T' switch are available. Both methods are used to amplify sound over the telephone. Hearing aid compatible phones should be provided for all hearing impaired employees and for hearing impaired customers who rely on a hearing aid. Volume controls and compatible telephones are a must in any public building.

2. Telephone Devices for the Deaf (T.D.D.s):

T.D.D.s should be available in all public buildings for deaf individuals who need them. T.D.D.s can be used with the ordinary household telephone and used to type messages to deaf clients. The ordinary telephone can be placed in a coupler which is attached to a specially adapted keyboard terminal which looks like a very small typewriter. When a person starts to type a message, the coupler transmits an audible signal over the telephone line to another T.D.D. which receives the signal and either prints the message on a hard copy (paper) or shows it on a visual display screen.

Transporation terminals such as Via Rail and Air Canada terminals, some hotels like the Inn-on-the-Park in Toronto and many businesses,hospitals and emergency centres have purchased T.D.D.s and noted that more hearing impaired people use their service.

3. Visual Announcements-

Public locations should be augmented with visual display screens, much like the ones used in some subway stations or television screens similar to those used in airports. The visual announcements will compliment the spoken message and will be appreciated by hearing people as well as hearing impaired individuals.

4. Printed Directions:

All public buildings should have clearly printed directions so that hearing impaired people do not have to struggle with the difficulty of asking questions.

5. Sign Language Interpreters:

Sign language interpreters are people who specialize in the area of languages used to communicate to many deaf people. They act as interpreters between deaf and hearing people. Employees in a public place should have ready access to sign language interpreters so they can be called to provide the service when needed.

6. The Loop System:

The loop system makes use of an insulated wire strategically placed for use by the hard of hearing person.

A wire picks up an audio signal from the P.A. system and creates a magnetic field that can be converted back into sound using a special receiver. A loop allows hard of hearing people to focus on the main sound source such as the speaker and it allows background sounds to be cut out. If a person is wearing a hearing aid with a 'T' switch the hard of hearing person uses the hearing aid to pick up the sound.

It is suggested that any public building where announcements are made on a regular basis over a public address system should have a looped area for hard of hearing people. Of course this area should be clearly identified. The hard of hearing person would simply find that area, turn the hearing aids to the 'T' switch and listen to the amplified message.

Heathrow and Gatwick in England are examples of airports that have installed a special "looped" area for hard of hearing travellers.

7. Specialized Sound Systems:

Public areas can be made accessible to hard of hearing people by installing special amplification systems such as the FM and Infrared systems.

With the FM system,the transmitter sends signals to the user receivers by way of wireless, designated radio waves. The speaker uses the transmitter. The receiver, which the hard of hearing person wears, is the size of a deck of playing cards and allows the hard of hearing person to adjust the volume of the sound. These systems can be used with or without a hearing aid.

The Infrared system is similar to the FM system, but uses light energy to transmit the signal from the speaker's transmitter to the hard of hearing person's receiver.

FM and/or Infrared systems should be kept at a central point such as a reservations/information counter so when a hard of hearing person needs information the systems are readily available to ease communication.

8. Smoke and Fire Alarms:

Fire alarms and smoke detectors in all public places should be equipped with flashing lights. Visual smoke and fire alarms should be installed, particularily in areas such as washrooms. These devices, that would have flashing lights, would ensure that people with any degree of hearing loss would be aware of any emergency when it happens.

9. Printed Information:

Maps, floorplans, pamphlets, schedules, price of admission, hours when open, posters, billboards etc. should be readily available at no extra cost to hard of hearing people who need visual information to enhance their knowledge of what is going on.

10. Lighting:

Good lighting is essential to enable better lipreading skills and also better manual communication.

11. Electrical Interference:

Anti-static treatment of carpets and increased humidity will help to reduce electrical interference which affects hearing aids.

12. Staff Training:

Most important of all is staff training to develop awareness of the problems of hearing impaired people, and some understanding of their areas of communication difficulty. For example, it is recommended that personnel such as airline crew be made aware of the most effective methods of communicating with deaf and hard of hearing people to ensure that these individuals realize maximum value when they travel.

13. The International Symbol of Hearing Impairment:

It is suggested that the International symbol of hearing impairment be used to identify any building that is accessible as well as any areas inside the building that is accessible to deaf and hard of hearing people. This will ensure easy identification so that the hearing impaired individual knows that assistance is available and how to obtain such assistance.

As more and more people become aware of hearing health care assistance, they will have less difficulty travelling and will enjoy travel activities more. Due to the fact that hearing impairment is more prevelant in the elderly population, more people will be inclined to use the devices available to them.Eventually seniors and hard of hearing people of all ages will look for facilities that are accessible to them as there will be more services available for them to improve their quality of life. They will soon begin to expect these services.

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COMMUNICAID: A COMPUTER AIDED COMMUNICATION SYSTEM TRAVELLERS WITH SENSORY OR SPEECH PROBLEMS

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ABSTRACT

This paper describes the design, development, and function of Communicaid, a high technology communication system which allows travellers with sensory or speech deficits to use a computer to obtain information about a transportation terminal site, or to enter into a dialogue with an attendant to make preliminary flight arrangements. The account stresses the fact that all stages of development were guided by ergonomic principles. Methods of evaluation and the future of Communicaid, now at prototype stage, are discussed.

INTRODUCTION

Communication capability, which involves accurately sending and receiving sensory messages (1), is clearly necessary in order to travel. And nowhere during the various stages of travel is this ability more critical and more difficult to exercise than it is at a transportation terminal. At such a site, a dazzling plethora of stimuli simultaneously impinge on the senses of the traveller who, likely already stressed by hurry and uncertainty, must struggle to marshal enough perceptual and cognitive capacity to ensure that communication episodes are satisfactory. Understandably, any difficulties in the process will be magnified for those with sensory or speech deficits, perhaps so much so in some cases that independent travel is prohibited.

Communicaid, a comprehensive high technology communication system, designed by Rutenberg Design Inc. for Transportation Development Centre (TDC), purports to overcome this implied transportation barrier. Essentially, it is a work station where communication-impaired individuals can use a computer system (a) independently to obtain information specific to a given transportation terminal, and/or (b) to send or receive visual messages in a dialogue with an attendant who can be summoned to assist with flight and seat selections prior to passenger handling at the ticket and check-in counters. Presently the Mark I prototype is installed at Vancouver where it will undergo rigorous field evaluation during Expo 86. This paper describes the design and function of the system, with particular attention being given to the ways in which its development and evaluation are being guided by ergonomic principles.

BACKGROUND

The basic concept of Communicaid emerged as a result of two earlier TDC exploratory studies. The first of these described the relevant domain of available technology which had potential for use by sight-, hearing-, and speech-impaired travellers. (2) The second examined a number of these devices at Dorval International Airport in simulated scenarios involving airlines personnel and communication-impaired 'passenger' subjects at the ticket and check-in counters. (3) The approach taken was that of theoretical ergonomics which sees the operator and equipment exchanging information as parts of one system in a given environment. (4,5) In this information-processing model, the operator/machine system will work safely and efficiently only if the machine and the environment are designed to accommodate the sensory, perceptual, cognitive, physiological, anatomical, and biomechanical capacities of the operator. (4,5)

A major finding of the Dorval study was that none of the devices tested was ergonomically suitable for such an environment. In particular, it was clear that (a) no currently available device could be used in this type of setting without invading the personal space of a dialogue partner, (b) the synthesized voice output of those models having this feature was inclined to be difficult to understand as well as unattractively tinny and monotonous, and (c) the communication process was very much encumbered by lack of access to words and phrases specifically relevant to the content of dialogues characteristic of a transportation terminal.

Yet, the Dorval study also made it clear that communication technology had a facilitative role to play in transportation terminals, generating as it did definitions of the target populations' unmet communication needs at these sites, as well as preliminary specifications of a system that would ergonomically address them. The emerging concept was one permitting communication-impaired travellers to obtain essential site information and to discuss flight arrangements in a manner totally convenient to both passenger and attendant.

From this first, bare-bone conceptualization, Communicaid evolved through numerous drawings and mock-ups to its present prototypical form, careful attention being given every step of the way to ergonomic considerations, including those in the rather voluminous literature on computer ergonomics. (6,7,8,9,10)

PROTOTYPE DESCRIPTION

Overview of Technical Features and Design

The Communicaid work station, for which an exterior view appears in Figure 1, is housed in a sea-green metal mesh cylindrical enclosure 2.44 m in diameter and 2.75 m high, with an opening of 1.14 m for the passenger on one side and another of 64 cm opposite for the attendant. The design and materials used to construct the station are meant to afford relative privacy in a well-lighted, noise- and glare-free environment, while maintaining visual appeal and a sense of airiness. The word "COMMUNI-CAID" in large letters, along with symbols familiar to the sight-, hearing-, speech-, and motor-impaired, inform approaching target travellers of the general function of the station.

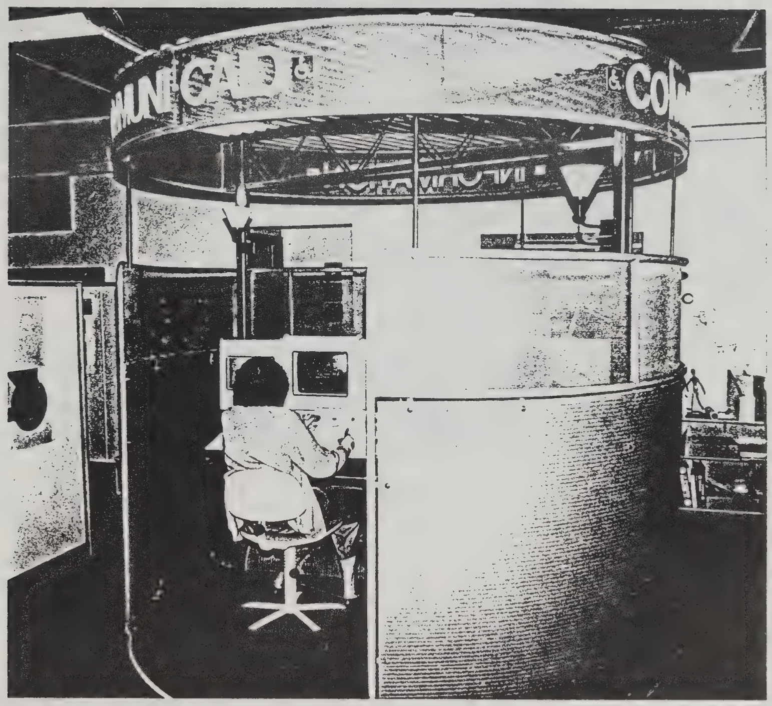

Figure 1. Communicaid exterior, showing large entrance for passenger.

The inside layout is diagrammed in Figure 2. The work space was configured to maximize comfort and operational efficiency, and to allow passenger and attendant, when summoned, to effect eye contact if necessary or desirable wile maintaining a comfortable sense of personal space.

Some computer hardware and software for Communicaid were able to be purchased off the shelf. However, because of the specialized nature of the target populations' deficits, most of it had to be developed in accordance with Rutenberg's designs. This part of the project was carried out largely by Teklogix Inc., which also set up the system, using a 20 MB IBM PC AT

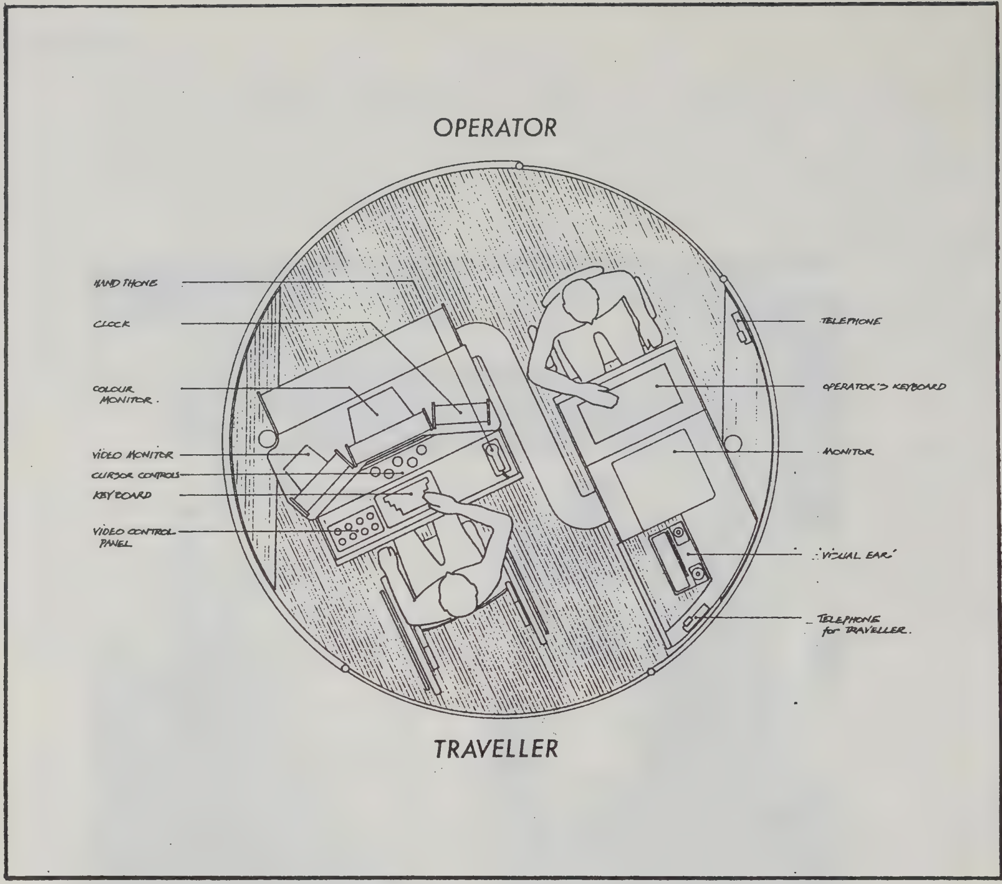

Figure 2. Layout of Communicaid, as seen from the top.

as the CPU. Software and hardware for the speech synthesis components were developed by the Centre for Speech Technology Research (CSTR) in Victoria. How the various components function as an integrated communication system will become clear as the description proceeds.

Components and Their Functions

Independent retrieval of information. On entering the station, the traveller trips off an invisible light switch which activates an introductory synthetic voice audio loop explaining (in English and French) how Communicaid works, what sort of information can be obtained from it independently, that visually-presented menus are available through a TV monitor in front, auditory ones through a handset to the right of the monitor, and that an attendant can be summoned for computer-aided dialogue if desirable. (A considerable amount of research preceded decisions regarding the synthetic voice components of the system; however relevant discussion will be postponed until the reader has been made more aware of how Communicaid functions.)

Once inside the station and comfortably seated in a well padded swivel chair, the passenger finds a number of system components available. A colour TV monitor presents the visually capable with an introductory loop similar to the auditory presentation described above, as well as with displays of psycholinguistically designed menus (in English or French) in six categories of information relevant to the site - Schedules of Flight Departures and Arrivals, Airport Facilities (restaurants, washrooms, etc.), Ground Transportation (taxi, bus, etc.), Airline Counter Locations, Expo 86 and Canada Pavilion Accessibility, and Hotels in the Vancouver Area. Oversized control buttons, four for directing the cursor to a selection and one for registering it, enable even those with poor finger dexterity to operate the system using a fist if necessary. The configuration of the directional cursor buttons is such that it complies with the principle of stimulus/response compatibility for motion controls, thus minimizing confusion regarding the meaning of the buttons. (11) To the passenger's left, a monochromatic monitor, fed directly by the databases for four airlines, displays flight departures and arrivals when this option is selected from the main directory. A laser printer produces hard copies of maps and other materials within seconds of request, when the option is available, through a tray on the right underside of the work table.

The partially sighted, guided by instructions presented over the synthetic voice audio loop mentioned above, can access similar menus through a telephone-like handset to the right of the colour monitor. Listeners are advised to press any key on the QWERTY keyboard in front of the monitor to make a selection. In keeping with the well known limits on human information-processing (12), not only have the audio lists been kept short, but also some redundancy has been provided through key words which appear in very large letters on the colour screen, as shown in Figure 3. As mentioned earlier, development of the synthetic voice for Communicaid was based on careful review of relevant research, as well as of existing forms many of which could present serious problems of comprehension in an airport environment, even for those with only <u>slight</u> hearing impairments. It is well known of course that, in natural speech, variations in pitch, intensity, and duration of phonetic segments and words are modulated by a complex interaction of physiological, phonetic, and linguistic factors to provide the listener with acoustic cues which aid in comprehension. (13) The use of only a limited set of rules for manipulating these cues in some forms of synthetic speech appears to result in degraded representations which bring about not only poor word pattern recognition but also increased processing demands in short term memory and, hence, to acount for difficulties observed in the perception and comprehension of the output. (13) In developing the synthetic speech for Communicaid, CSTR applied the economic linear predictive coding method for speech compression and obtained remarkably human quality by (a) using words and phrases (rather than letters or phonetic segments) as basic units for storage, thereby retaining much of the influence of phonetic units on adjacent ones, and (b) applying stress and intonation rules which alter the sounds of words according to their contexts within phrases and sentences. (14)

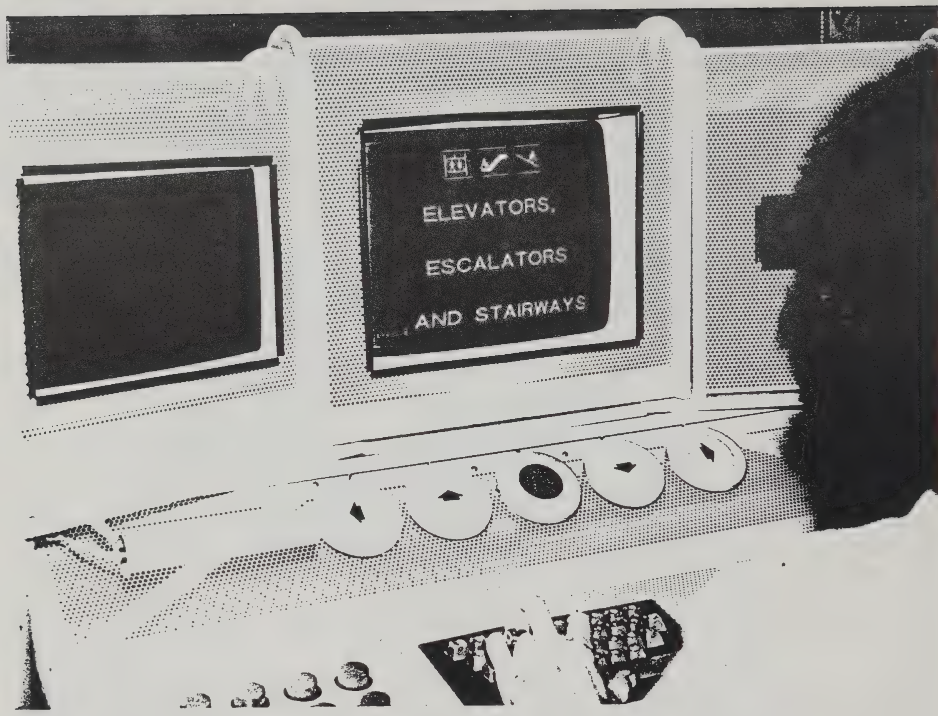

Figure 3. Use of large-print key words on the screen provides redundant coding for the partially sighted who receive menu choices by synthetic voice. (The large cursor control buttons can also be seen, although not in their final configuration).

Passenger/attendant dialogue. Inasmuch as those with only sight impairment have no difficulty with oral communication, the dialogue function of Communicaid was designed around the needs of travellers with speech and hearing problems. Such individuals can indicate the desire to enter into dialogue with an attendant by selecting the "Operator Assistance" option on any of the menu screens. This selection activates a signal at the Transport Canada information booth, in response to which an attendant will arrive to take up position on the opposite side of the work table and assist the passenger through computer-aided dialogue with flight and other arrangements. At the disposal of the attendant, are a monochromatic TV monitor, a full QWERTY keyboard, and a telephone connected to all airlines. The 'Operator's' work station can be seen to the travellers's right in Figure 4.

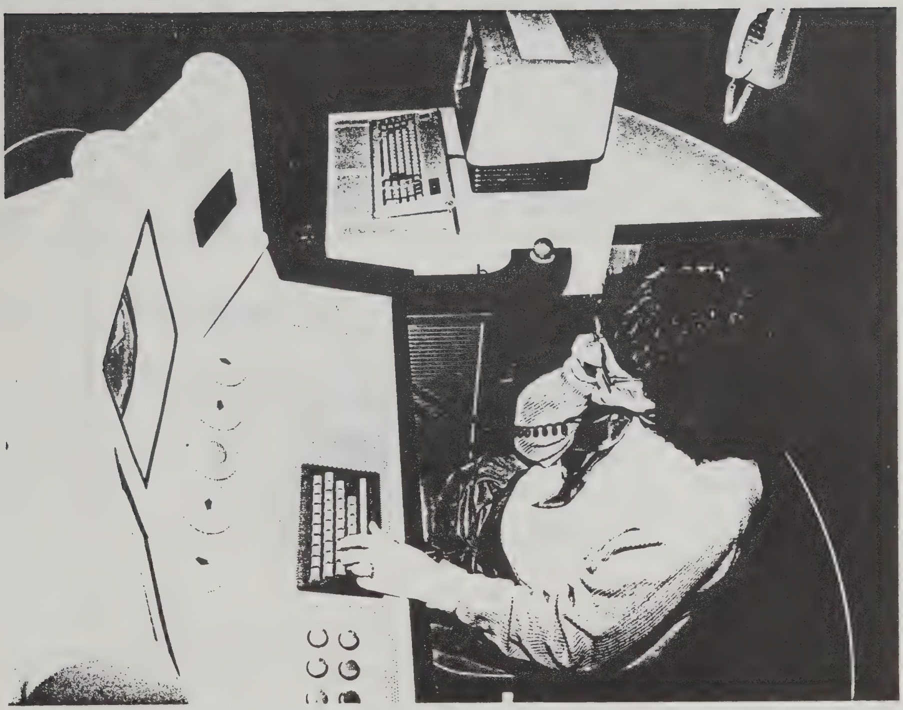

Figure 4. View of Communicaid showing "Operator's" work station to traveller's right.

The "Operator Assistance" selection also results in a new screen on the passenger's colour monitor, this displaying both an alphabetical and QWERTY keyboard, along with space for messages keyed in by sender and receiver. Travellers with speech difficulties then have a choice of keying in messages using the cursor on either of the two screen keyboards shown in Figure 5 or, if finger dexterity is adequate, using the table QWERTY keyboard. Symbols

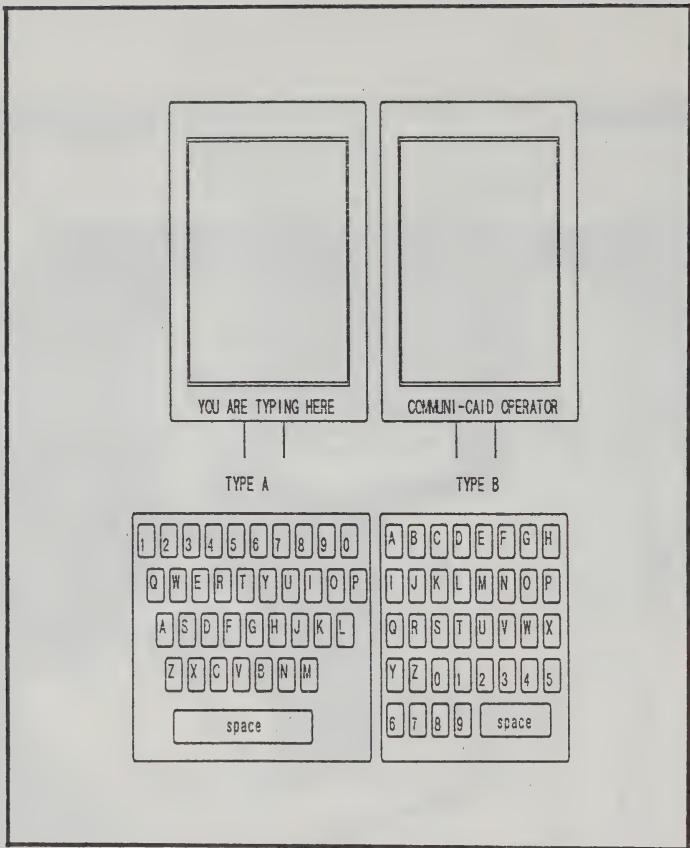

Figure 5. Screen appearing on selection of "Operator Assistance", ready for passenger/attendant computer-aided dialogue.

and capitals have been removed from both QWERTY types in order to simplify usage. Depending on the hearing capacity of the passenger, the attendant will respond either vocally or by keying a response into the computer. Those with hearing but no speech production difficulties, can express their needs vocally, if they wish, and rely on computer-aided responses from the attendant, In the case of either type of passenger, the attendant can also provide a printout of any flight or other arrangements made, which the passenger can take to the ticket or check-in counters to facilitate processing there.

Hotel reservations. To supplement the functions described above, a wall-hung telephone has been installed just inside and to the right of the Communicaid entrance. Thus, after obtaining relevant information from the Accommodation menu, passengers having speech and hearing capability can immediately place a reservation at a suitable hotel. This component is expected to have limited utility until such time as technology accommodating the deficits of the target populations can be developed.

EVALUATION

As stated earlier, Communicaid will undergo field evaluation during EXPO 86. In keeping with procedures for obtaining reliable and inclusive information, the assessment will comprise a set of converging operations. First, the visual presentation contains an evaluation questionnaire which, although it may be ignored by many users, nevertheless has the advantage of providing data based on the immediate experience of those who choose to respond. Secondly, monitors manning the station during the Expo period have been trained to elicit as much information as possible from users about their reactions to the system, both negative and positive. Data from this method are expected to provide general indications of system acceptability and deficiency. Finally, an in-depth and systematic task analysis, based on the model developed by Berliner and colleagues, will be carried out with a small number of subjects, the purpose in this case being to force the emergence in fine detail of system features which presently violate perceptual, cognitive, or motor limitations and, therefore, require modification. (15) With feedback available from all sources, further development should produce a Mark II version of Communicaid that is ergonomically suitable in every respect.

THE FUTURE FOR COMMUNICAID

If it can be understood that an innovative piece of technology cannot be expected to perform perfectly on its first entrance into the field as a Mark I prototype, the future for Communicaid will be bright indeed. Although first reports are encouraging, expectations are that it will be some time before Communicaid is taken for granted as an integral part of a transportation terminal landscape by a population that may be timid about travelling alone, never mind interacting with a high technology device however appealing its design. Still, reports such as that of Feigenbaum and McCorduck in their recent book "The Fifth Generation" remind us that we are now into the second computer revolution, into the Information Age in which computers that reason and inform will become indispensable. (16) The concept of Communicaid is of that ilk, and there is little doubt that its utility will grow along with its form as development responds over time to evolving needs.

ACKNOWLEDGMENTS

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ADVANCES IN VEHICLE CONTROL CONVERSIONS FOR DISABLED DRIVERS

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Advances in Vehicle Control Conversions for Disabled Drivers

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INTRODUCTION

A considerable number of locomotor disabled people require adaptations to the controls of a standard car (or other vehicle) in order to be able to drive. Such adaptations include conversion from foot operation to hand operation; conversion from hand steering to foot steering; and re-location of the minor controls. By means of such adaptations, many disabled people are able to drive and are thus able to achieve independent personal mobility.

Early conversions were fairly simple and, as such, only fulfilled the needs of a proportion of disabled people - those less severely disabled. The use of hydraulic systems and power assistance extended the range of people able to drive and with these - still relatively straightforward - conversions, more severely disabled people (e.g. high tetraplegics) became able to drive.

Over the past few years, the advent of micro-electronic technology has provided the means whereby more sophisticated conversions could be produced at lower cost. Some conversions using such technology have become commercially available.

This paper describes a research project intended to examine the feasibility of converting a vehicle to "minimal effort" controls using electronic (and other) systems. The project was initiated by a charity called Motability, which is also briefly discussed in the paper.

The project is now virtually complete and has proved that the concepts involved are technically sound. It is hoped that the conversion will become commercially available in the relatively near future.

EARLY CONVERSIONS

Various methods have been used to enable vehicles to be driven without the use of legs (e.g. the description by Douglas Bader of using a walking stick as a lever!).

In the UK, various companies were set up for the purpose of

converting vehicles to hand control operation (e.g. Reselco in 1934). The technology used was extremely straightforward - mainly simple levers operated by hand and acting on the foot controls. Although adequate for brake and accelerator, such a technique is not really adequate for control of the clutch and so hydraulic assistance was provided (using vacuum from the inlet manifold).

Although relatively unsophisticated, such techniques were used for the vast majority of conversions until the 1970s.

Perhaps the only significantly different conversion was that to allow foot control of the steering for people without use of their arms. Such conversions were not, in principle, significantly different from those outlined above (using a chain to operate the steering, rather than the use of levers) but, due to the numbers involved, were very much more expensive.

The simple conversions described above provided (and still provide) for the needs of a large number of disabled people (e.g. paraplegics and low tetraplegics) and are thus of considerable importance.

However, there are a substantial number of disabled people whose needs are not met by the above.

ADVANCES IN TECHNOLOGY

With changes in technology (and, possibly, an increase in purchasing power of disabled people), it became possible to develop more sophisticated conversions, thus increasing the range of disabled people able to drive.

First, there were improvements in the technology of power assisted steering. Instead of being an optional extra on fairly expensive cars, it became possible to fit PAS to relatively small, cheap cars and also to provide very high power assistance, significantly reducing the effort needed to steer the vehicle. A further development (by a company called Steering Developments Ltd) combined extremely light steering with a remote valve, allowing the car to be steered with slight movements of the arm, fitted into a sleeve on the door.

A second development relevant to this paper was that of "joystick steering". This arose from work at the Transport and Road Research Laboratory and the University of Reading and is currently commercially available (although very expensive). In simple terms, a joystick actuates a powerful motor which acts directly on the steering column. For safety reasons, the motor is triplicated.

There has been relatively little use of modern micro-electronic technology but one application that is worthy of note is that now available from Kempf in which voice recognition is used to

operate the minor controls.

MOTABILITY

From the inception of the National Health Service in 1948, the UK Government had provided for the mobility needs of disabled people by the provision of the "invalid tricycle", originally a low-powered, three-wheeled vehicle. Indeed, the "trike" was a direct descendant of the motorised bath-chairs provided by the Red Cross following the First World War.

Around 1970, the trike had evolved into a fairly sophisticated vehicle with an automatic gearbox and a top speed similar to that of some small cars. There was considerable criticism of the trike for various reasons. In particular, its safety record was not good (it was a three-wheeled vehicle); it could only transport the driver; it was conspicuous, labelling the driver as disabled (although this could also be viewed as an advantage); finally, and perhaps most important, it only fulfilled the needs of a relatively small proportion of disabled people - those who were able to drive the vehicle.

In 1971, the Government set up an enquiry under Baroness Sharp to examine the future of the Vehicle Service. The main findings of the Sharp Report were that the trike should be replaced by small cars but, as she had a "nil cost" constraint, recommended that the issue of cars should be restricted, mainly to people who required them to get to and from work.

In 1975, the Government announced that it would introduce a new cash allowance for those who were "unable or virtually unable to walk" as an alternative to the provision of a vehicle. A year later, they announced that no further vehicles would be issued (except to special categories such as war pensioners).

Although the advent of Mobility Allowance had two significant advantages - it allowed freedom of choice and it was given to people too severely disabled to drive - no capital sum was provided and thus it was extremely difficult to save the money to buy a vehicle.

The Government considered various alternatives and, in 1977, asked Lord Goodman to set up a charity (later called "Motability") in order to allow recipients of Mobility Allowance to make best use of that allowance and, effectively, to commute the allowance into a capital sum.

The Leasing Scheme

Motability started operations in 1978 and the first scheme it introduced was leasing. Mobility Allowance recipients agreed to pay their allowance to Motability for a specified period (three

or four years, depending on the car manufacturer) and, in return, they received a car. If the value of the allowance was insufficient to meet the cost of the lease, the recipient had to provide a cash "down payment". The lease covered servicing but excluded other running costs such as insurance and petrol.

During the last eight years, the costs of the scheme have varied depending on interest rates, the rate of Mobility Allowance and the cost of vehicles but, at the time of writing, there are 25 vehicles available with no down payment required and, in the case of four of these, the insurance premium (a fleet scheme) is also covered. Thus, in the case of these cars, the disabled person has only to pay for petrol (and any conversions required).

Over the last few years, Motability has introduced other schemes including hire purchase (on new and used cars) and purchase of electric wheelchairs.

Since 1978, Motability has supplied over 60,000 vehicles to disabled people.

The Charitable Fund

Although the basic Motability schemes fulfil the needs of a considerable majority of Mobility Allowance recipients, there are still a significant number of people who require additional assistance. Often this is because their disability is such that larger vehicles (with high down payments) are needed, together with extensive adaptations.

Therefore, in addition to the facilities outlined above, Motability set up a charitable fund and, over the last eight years, this fund has disbursed about £ 1 million.

Organisation of Motability

Motability is registered as a company limited by guarantee and a charity. Its Chief Patron is Her Majesty The Queen and it has eleven other patrons, including the Prime Minister and the leaders of the main political parties. It has fourteen "Governors" (Directors of the company) and a Council (the Members of the company) which has a maximum size of fifty. All serve in a voluntary capacity.

Motability has a paid staff of about 45 and its administrative costs are met fully by a grant from Government.

The day to day direction of Motability is in the hands of an Executive Committee consisting of some Governors (including three who are themselves disabled), representatives of the Department of Health and Social Security and Motability Finance Ltd (the relevant finance company). It meets fortnightly and is attended by two paid officials, the Secretary and the Deputy Secretary.

There are two Sub-Committees of the Executive Commitee. One is the Charity and Public Relations Committee, the other is the Technical Development Committee.

The Technical Development Committee

This Sub-Committee was set up in 1979 in order to provide technical input to the Executive Committee. It has undertaken a number of projects (including the development of a steering wheel knob incorporating the minor controls) and was instrumental in initiating a survey of Motability customers.

However, its major activity over a number of years has been a research project aimed at providing minimal effort controls for severely disabled people.

THE TECHNICAL DEVELOPMENT COMMITTEE RESEARCH PROJECT

With the advent of micro-electronics, more sophisticated conversions became feasible. In 1981, Motability (on behalf of the Technical Development Committee) made a proposal to the UK Department of Health and Social Security (DHSS) for funding to investigate the feasibility of converting a vehicle to controls requiring "minimal effort". The first phase concerned the accelerator; phase 2 concerned the braking system and phase 3 the steering.

A number of basic concepts are common to the various phases of the project. First, the system should be modular so that items can be selected, depending on the particular disability, and integrated to provide the requisite control system. Secondly, there should be a standard electrical interface to the conversion so that the user controls can be decoupled from the conversion, allowing the former to be matched to a particular disability, while retaining commonality in the majority of the conversion. Thirdly, the cost (in production quantities) should be relatively low. Finally, the system must be fail-safe.

Phase 1

The major purpose of Phase 1 was to prove that the basic concepts could lead to a working system. In order to avoid many of the complications of other controls, Phase 1 concentrated on the accelerator. In particular, the "fail-safe" action is straightforward.

Phase 1 was approved by DHSS in 1981 and work started a short time later. Initial work examined various "cruise controls" since they performed a related function, namely control of the accelerator. However, they only provided a fixed throttle opening when activated (of the order of 70%) and were not flexible enough.

Nevertheless, cruise controls demonstrated the feasibility of using a relatively simple system to provide the requisite power. For Phase 1 of this research project, it was decided to use a windscreen wiper motor as the power source. There were two reasons for this choice; first, such motors are commonly available and cheap; secondly, they are highly reliable.

The "user interface" in the test vehicle was a simple lever whose only resistance to movement was brushes coated with silicone grease. Some resistance was necessary to obviate effects of cornering and gravity but, with these exceptions, the control was truly "zero effort". The only significant problem in Phase 1 concerned the fact that the vehicle being converted was automatic (as any production vehicle would need to be). The last 20% or so of the accelerator travel operates the gearbox "kickdown" which requires considerably more power and so the required system must be non-linear.

In order to overcome these problems, a geared motor and clutches were used, in a conventional PWM analogue feedback loop.

Phase 2

In theory, Phase 2 merely concerned braking but, since the brake and accelerator were required to be operated by a single control, extra work was required on the accelerator.

In broad terms, the effort required to operate ordinary hydraulic brakes is about 300 Newtons while the target effort for "minimal effort" controls was 5 Newtons. In order to achieve this, a substantial input of energy was required and this could be achieved by a number of methods, such as engine vacuum, high pressure hydraulics or electrical drive.

Since Phase 1 employed an electrical drive, this was the obvious candidate for Phase 2. In addition, it appeared to give substantial advantages over the other methods, especially flexibility. However, on close investigation, a number of disadvantages presented themselves: the energy required leads to a requirement for powerful (and hence large) motors. This implies a considerable consumption of electrical power. In addition, due to the safety requirements, at least two separate systems were required, each being able to operate the brakes fully in case of emergency.

These disadvantages could be overcome but were serious enough to indicate that other methods ought to be investigated. Since the brake system uses hydraulics in any case, the next candidate to be investigated was the use of powered hydraulics, using an engine-driven pump as the power source. In fact, in the final version, a two-part pump with a separate brake section was used.

Various options were investigated for the control valves. These could be simple hydraulic pressure-regulating valves but the valve

would have to be located in a wide variety of positions in different vehicles, thus requiring complex "plumbing". Furthermore, it would make the integration of other vehicle functions more difficult.

After investigation, it was decided to use a low-cost solenoid valve and to modulate its response to produce a proportional pressure which then operated the main regulating valve. This is controlled using digital PWM techniques operating at 200 Hz.

The system was duplicated for safety reasons and, in the original version, the system operated against a spring to keep the brakes off; thus, in the event of power (or other failure), the hydraulic fluid could bleed off, enabling the spring to operate the brakes gently (allowing the driver to maintain control for long enough to move the vehicle to a safe position).

Although this method was intrinsically exceptionally safe, this led to severe disadvantages (such as the fact that partial failure of the system could halt the vehicle). Thus, in the final version, the system operated in reverse, that is, the "normal" position of the brakes was off and the system applied them as required (for example, in the case of failure).

Further consideration of the accelerator suggested that a hydraulic system could also be used, thus integrating it better with the braking system. This was too complex and therefore rejected. Instead, the earlier system was used with some changes, especially the use of a Printed Armature DC motor operating through a 3:1 ratio on to the linkage close to the carburettor.

Phase 3

The major objective of Phase 3 was to produce "minimal effort" steering and to integrate this with the accelerator/brake control from Phase 2.

Various work has been undertaken in the past to provide such control of steering as described above. A combination of the two approaches described was used for Phase 3 of the Motability development.

First, ordinary (hydraulic) power assisted steering was fitted to the test car (a Ford Escort), then an electric motor used to power the steering column (now requiring very much less effort). Thus the motor becomes, in effect, a modulator for the standard power steering control valve.

The input characteristics of steering vary considerably with the speed of the car (as well as the steering characteristics of the car itself). At manoeuvring speeds, it is necessary to provide full travel of the wheels (from lock to lock) but at high speeds (e.g. 70 mph) less than 90 degrees (i.e. 15%) of wheel movement is required. Indeed greater movement is potentially dangerous.

Also the speed of response of the wheels has to be different over different speed ranges and in different conditions.

Maps of the various relationships were programmed into the controlling microprocessor and a programme of testing is now being undertaken to determine the optimum settings.

Since the conversion is intended for use by people with widely differing disabilities, widely differing response characteristics will be required. It is envisaged that, in a production system, the characteristics of the user would be determined and programmed in to the conversion during fitting. It is of interest to note that the various user requirements (whether disabled or not) can be widely different and this appears to be an interesting research area.

As described above, the system uses an electrical motor applied to power assisted steering. However, in the case of some vehicles, the steering is light enough for the hydraulic power assistance not to be required and so the motors could be applied directly to the standard steering system.

The system is implemented using digital microprocessor-controlled servo loops and the use of digital techniques makes it very much easier to modify the characteristics of the steering.

Another advance in technology that has been used (indeed, required) is the development of power semiconductors which are able to control the motors from a single 12 volt supply with maximum efficiency (i.e. low power loss). Such devices have only become available over the last twelve months and, without such devices, it would not have been possible to utilise high energy electrical actuators.

A major concern in all this work has been safety. At present, a full Failure Mode analysis is being undertaken.

However, no single "fail-safe" strategy can be defined with respect to steering. Therefore the system has been designed to fail in a controlled (predictable) manner so that there is always enough of the system working for enough control to be maintained.

In the present version, the electric motor is duplicated and the two motors and their control circuits are continuously monitored by the supervisory processor.

In a full production version, it would be necessary for every component to be duplicated, including the battery and even to ensure that two separate conduits were used.

For the prototype vehicle, the various controls have been integrated so that, by use of a two-axis joystick, steering, brakes and accelerator can be controlled. For test purposes, any of these functions can be switched off.

CONCLUSIONS

The three Phases of this project have demonstrated the feasibility of using modern technology to provide "minimal effort" car controls. At the time of writing, the final Phase has just been completed (and is being written up); this has resulted in a car whose steering, brake and accelerator can be controlled using virtually zero effort. In the prototype, this control is effected by a simple joystick but, because of the decoupling of the "user interface" and the control mechanisms, it could be replaced by whatever was required for the particular user's disability.

Although difficult to cost at the present time, it is anticipated that, in small production quantities, the cost of the full conversion should be around £ 3,000. At present, the possibility of production is being investigated.

ACKNOWLEDGEMENTS

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ERGONOMICS REQUIREMENTS FOR MINIBUS FOR DISABLED AND ELDERLY PEOPLE

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INTRODUCTION

In Britain, minibuses are used extensively to transport disabled and elderly people. These are vehicles for up to 16 passengers based on vans or built onto the chassis of small trucks (Plate 1). They are sometimes fitted with lifts for wheelchairs and for passengers who have difficulty climbing stairs. In March 1984 there were some 63300 vehicles registered as minibuses having seats for 9 to 16 passengers (Walmsley 1985). Of these probably about 10 per cent are used specifically for carrying young people, the elderly, or sick and disabled people.

The ergonomic requirements of elderly and disabled people using full sized buses have been established by a number of studies (Brooks et al, 1974; Leyland Vehicles, 1980; Oxley and Benwell, 1985). However, the small size of minibuses generally makes it impossible for them to satisfy all of these known requirements. Many minibus operators report complaints from passengers, drivers and attendants concerning difficulties over boarding and alighting, or discomfort while travelling (Lightfoot, 1982). For these reasons the British Department of Transport decided to determine how far it would be practicable to improve the ergonomic design of such minibuses for elderly and disabled people, and in 1984 the Department's Transport and Road Research Laboratory commissioned the The Motor Industry Research Association to conduct the necessary investigation. The study, which is aimed at conducting an ergonomic specification for immediate practical application rather than a theoretical concept, is due to be completed by the end of 1986. This paper describes the results obtained up to spring 1986 and the work now being done. It is hoped that the project will lead to substantial improvements in the design of minibuses for elderly and disabled people without significant increase in cost. It is accepted that the numbers of minibuses built for use by disabled people will always be relatively small, and that some features that are technically desirable may be economically impractical. It is not yet established whether it it economically practical to consider a purpose-designed vehicle (especially if an international market is considered), or whether the design of minibuses in practice must, for the foreseeable future, be constrained by the need to use chassis and mechanical components developed for small trucks.

STUDY OBJECTIVES

The main specific objectives of the study are:

(i) To provide data for the design of entrances/exits and passenger compartments, such that the minibuses provide safe and comfortable travel for disabled and elderly people, including those in wheelchairs.

(ii) To prepare an ergonomic specification for a minibus that represents the best balance between the ergonomic requirements of passengers and operating staff and the economic and practical constraints of using commercially available components and production quantities.

(iii) To assess the variation in costs arising from accommodating groups with different disabilities and with various proportions of the disabled and elderly population.

Throughout the detailed specification of the study the emphasis is on determining the requirements of disabled people in the context of travelling by minibus, and then finding the best practical way to design a minibus which most nearly satisfies these requirements without increasing the cost of the vehicle to an unrealistic level.

DESIGN OF THE STUDY

To achieve the objectives listed in the previous section, the study was planned to include the following activities, specifically in the context of the use of minibuses by disabled and elderly people:-

1. Identify the needs of users and operators of minibuses.

   (i) Consult with passengers and staff at about 10 organisations operating minibuses (the pilot study).

   (ii) Observe the use of different minibuses in service.

   (iii) Inspect and measure a wide range of current minibuses.

2. Review existing relevant ergonomic data and standards.

3. Conduct experimental studies to provide ergonomic data not currently available for a population of minibus passengers. The studies should obtain information on:

   - Doorway dimensions including entrance handrails
   - Relative positioning of steps and door aperture, including external steps
   - Space between doorway and gangway
   - Internal stanchions and grabrails
   - Ramp angles for wheelchair access
   - Detailed use of wheelchair lifts with and without assistance
   - Stowage of wheelchair lifts and ramps

   The experimental study should take the following form:

   (i) Construct an adjustable ergonomic rig to represent a minibus, including a doorway with steps, a wheelchair lift and internal seating.

   (ii) Select about 200 subjects to provide examples of the range of disabilities among minibus users, and to include a small control sample of able-bodied people.

   (iii) Conduct tests to quantify the ergonomic requirements for entrances, internal configuration, seating, and lifts, and to identify desirable design features of minibuses.

   (iv) Conduct tests to measure the quality of ride in a number of minibuses.

4. Develop an ergonomic specification for practical minibuses for use by disabled and elderly people.

   (i) Draft initial specification, bearing in mind the economic constraints of practical vehicles.

   (ii) Consult with operators and manufacturers.

   (iii) Confirm the validity of the specification by setting the ergonomic rig to replicate the specification and demonstrating its acceptability by user trials.

   (iv) Finalise specification.

This programme started in September 1984 and is expected to be completed by the end of 1986.

PILOT STUDY

The first stage of the project was in effect a pilot study to identify the needs of users and operators. To maximise the coverage of this survey it was decided to consult users and operators across as wide a range as possible of types of vehicle, disablement of client, operating condition and type of service. Ten operations were selected for the survey during the early part of 1985. The consultations with each group was essentially the same and took the form of structured interviews with the Transport Manager, drivers and attendants, and users. These interviews were mainly conducted as one-to-one sessions, though some group discussions were also held. Each type of respondent answered a questionnaire designed to their own interests and requirements. Members of the experimental team also travelled with the clients of each operation to observe typical routing and the use of the vehicle by the client. This observation was subsequently backed-up by video recording of complete journeys including loading and alighting procedures. These video records were then assessed by a panel of ergonomists who rated subjectively the acceptability of various vehicle design features to each individual subject. These observer ratings could then be correlated with clients own ratings of the vehicle from the interview sessions, and also the abilities of that client and the specification of the vehicle used. For this reason detailed specifications of each vehicle examined were also drawn up. The analysis of this survey data therefore identified both commonly reported and observed deficiencies with current minibus designs and their associated equipment.

ERGONOMIC RIG

To examine the interaction of certain detailed features of vehicle design and the abilities of potential clients a simulated minibus body rig was constructed. This ergonomic rig took the form of a large windowed 'passenger compartment' having overall dimensions of 6 metres in length, 2 metres in width and 2 metres internal height. The rig was fitted with three entrance points. Two of these were equipped with wheelchair lifts and the third was

dedicated to an entrance with steps and handrails, the geometry of which could be adjusted. The adjustable steps were so designed that they could be removed from the main body and used independently as a separate rig if required. Facilities were provided at each doorway to adjust the height and width of entrance. In addition the two lift doorways led to a internal floor marked out with a grid pattern to enable assessment of wheelchair space requirements during entrance, parking and exit manoeuvres.

Inside the compartment, seating was provided on sliding,lockable mounts to enable assessment of the acceptability of inter-seat spacing for both knee room, seat entry/exit and gangway width. Adjustable stanchions were also fitted internally. The entire compartment was mounted on a trailer chassis so that it could be readily transported to user groups to enable experimental assessments to be carried out on site at various locations. Therefore facilities for power, lighting and heating were also fitted internally.

To summarise, dimensional information could therefore be obtained on the features outlined in the design of the study description. Specifically:

Wheelchair Lifts - Size of platform, location of handrails, related wheelchair manoeuvring space.

Doorways - Width, height.

Steps - Height and spacing, width, depth, associated handrail positions, associated doorway height.

Seating - Knee room, gangway width.

Handrail Stanchions - Separation distance.

In addition, subjective ratings could also be obtained on the following features.

Wheelchair Lifts - Handrails design, safety, stability, ease of use.

MAIN EXPERIMENTAL STUDY

The user trials were conducted using the simulated minibus body and employed three procedures. Any specific subject would only experience one of these procedures. Each procedure was developed for subjects with a defined range of abilities, and is discussed below.

PROCEDURE 1 - For all subjects able to use the steps to enter the minibus.

i) Maximum step height with associated step tread depth and doorway headroom were assessed.

ii) Comfortable step height with associated step tread depth and doorway headroom were assessed.

iii) Minimum acceptable knee room was assessed.

iv) Minimum acceptable gangway width was assessed.

v) Passive and functional arm reach capabilities were assessed.

PROCEDURE 2 - For ambulant and semi-ambulant subjects who could not use steps but required a lift to enter the minibus.

i) For each of the two lifts the subject was asked to rate the following features on acceptability rating scales.

- Platform length, width, stability
- Handrail suitability and stability
- Effectiveness and Operation of Toe-Guard
- Subjective Safety
- Overall rating of lift

ii) Required Doorway height was assessed.
iii) <u>Minimum</u> acceptable knee room was assessed.
iv) <u>Minimum</u> acceptable gangway width was assessed.
v) Passive and functional arm reach capabilities were assessed.

PROCEDURE 3 - For all wheelchair users.

i) For each of the two lifts the subjects (and their attendants if required) were asked to rate the following features on acceptability rating scales.

- Platform length, width stability
- Handrail suitability and stability
- Effectiveness and operation of Toe-guard
- Effectiveness of anti-roll off device
- Subjective safety
- Overall rating of the lift

ii) For each lift and associated doorway the minimum acceptable manoeuvring space required to park the wheelchair inside the minibus body was assessed. This was done using baffle boards <u>or</u> wheelchairs as moveable obstructions.

iii) Doorway headroom was assessed.

For each subject (and attendant) taking part in these procedures the following details were recorded, Name, Age, Mobility Details, Disability Details, Regular Walking Aid, Walking Aid used during trials. Each procedure completed was recorded on video for future checking and analysis. In addition wheelchair manoeuvring space was also filmed with an overhead mounted 35 mm camera.

Approximately 200 subjects have taken part in these trials at a number of Senior Citizen and Disabled Person day centres. This sample of people all travelled to the day centres by minibus, sometimes with some difficulty, and so was a representative sample of the elderly and disabled people currently using minibuses. There is no doubt that the sample was more disabled than

the sample used in the Leyland Vehicles study (Brookes et al 1974), and more disabled than would be a sample of elderly people using scheduled bus services.

RIDE

The reported 'harshness' of ride quality experienced in minibuses was shown to be an area of commonly voiced concern. Most minibuses are built on essentially a light goods vehicle chassis equipped with suspension designed for that use and not passenger transport. A series of tests were planned within the research program to determine objective measures of ride in order to provide comparison between minibuses and other means of passenger transport.

The real level of vertical accelerations experienced within converted vehicles over various road surfaces and load conditions were evaluated. The vehicles used were:

Dodge 50 series, standard suspension
Dodge 50 series, modified rear suspension
Renault Trafic, standard suspension
Mercedes 307, standard suspension

Each of these vehicles was assessed in loaded and unloaded conditions over rough and standard road surfaces at the MIRA Proving Ground. Vertical RMS accelerations were recorded in four locations in the vehicles. These four locations were at the floor and on the compressed seat at the mid-vehicle and at the rearmost seating position. These locations were chosen as potential worst case ones for comparison. It is likely that at least 3 more vehicles will be assessed in this way before the project is completed. These will include vehicles with alternative suspensions (such as air sprung and rubber suspension) if such vehicles can be obtained.

RESULTS TO DATE

The pilot study identified those areas that were most commonly reported as deficiencies of minibus design. These were combined with the panel assessments of the video recordings of clients using minibuses and a summary table (Table 1) is shown. From this data and the literature review a detailed scheme was developed which laid out the form of information required to provide the eventual ergonomic specification in a functional manner. The experimental trial of the main study was then designed to complete the gaps within the scheme and confirm some aspects of previous research. A simplified version of this scheme, or functional analysis, of the specification is shown (Table 2).

The results of the main study are under analysis at the time of writing. However some early results are available and are quoted below. These preliminary findings are therefore subject to confirmation from further analysis of the data collected. Areas are described where results indicate significant differences from previous studies or design requirements. These comments are therefore brief but are intended to give a profile of the initial analysis.

STEP AND HANDRAIL DESIGN

The estimation of population capabilities in ascending and descending step configurations was re-examined in the study. Previous work (Brookes et al 1974) had perhaps used a sample of higher ambulatory ability than those likely to use minibuses. As an example the work by Brookes suggested that almost all (98%) of the population could use a 200 mm step as a maximum achievable dimension. Only 75% of the present sample of minibus users were able to do so. A similar result is found for the 'comfortable' step height (75% of sample from Brookes and 50% of sample from current work with respect to the 200 mm step.)

Where the factors of effective doorway width and step climbing ability are examined the results indicate a significant interrelation between these design aspects. This relationship has been examined over doorway widths of 550 mm to 950 mm in 100 mm increments. At the smaller widths handrails on both sides of the entrance can be used at the same time but some obstruction to both manoeuvring and assistance from attendants is experienced. At the largest widths many users could only use the handrails at one side at a time which also restricted their ingress/egress abilities. The 750 mm effective doorway width between handrails was found to be the optimum.

There are also considerations of step tread depth. The general trend is that as step height increases the tread depth required decreases, however there are large inter subject variations. In all of these aspects of step design the 'worst case' is exit from the vehicle down the steps. This is therefore the limiting factor and the importance of good handrail design to assist balance and security when <u>leaving</u> the vehicle must be stressed. This is particularly acute as the user steps off the last step out of the vehicle with little or no handholds available. If handrails are available and reachable on <u>both</u> sides of the doorway then they <u>will</u> be used by the passenger.

SEATING DESIGN

There are differences in results obtained from the different aspects of using seats. Getting into the seat is easier and required less space between seats, than getting out. Highback seats to the front of the user can cause additional problems when leaving the set by virtue of the higher location of potential handholds and increased obstruction. The critical dimension for specification purposes in this respect is between the rearmost point of the seat in front (eg top of the the back rest) and the foremost point of the seat used by the passenger (eg

front edge of seat base). This is a markedly different dimension from the manner in which interseat spacing is defined in current standards such as the UK Public Service Vehicles specification. The space required to exit the seat is therefore greater than the space needed for comfortable kneeroom and should be defined in a different form.

GANGWAY DESIGN

Similar comments to those above can be applied to gangway dimensions. The effective restraint to access along gangways is at 'hip height' rather than a vehicle based dimension at seat squab level. Once more the observed behaviour of passengers should be used to define acceptable dimensions. The recommendation in the instance would be a minimum width of 530 mm at a height of 800 mm above the vehicle floor.

WHEELCHAIR MANOEUVRING SPACE

The early analysis shows that over a range of wheelchair types, if a wheelchair parking space is constructed that is 20 cm larger than the effective length of the wheelchair then virtually all users can manoeuvre into it. Effective length is used here to describe the total length dimension of wheelchair and user. This could therefore be described as tip-of-toes to rear of handles/wheels. This conclusion is drawn from tests using manoeuvring space confined by solid bulkheads. The results become more complex when seats or other wheelchairs are introduced as a more realistic obstruction due to the interaction effects between the wheelchair user and the obstruction. Generally less space is required in this situation.

DISCUSSIONS

The previous section gives brief and preliminary comments on the early results of the experimental study. They do support the subjective comments made by minibus operators, and the observations of difficulties in service noted earlier in the study. Many other factors and their interactions will be examined in the remaining analysis. However one aspect appears clear. The selection of a subject group representative of current UK minibus users for this experimental study has led to results which differ somewhat from those of earlier researchers. Simply, some aspects in these earlier studies provide optimistic estimations of the abilities of disabled and elderly people currently using minibuses. It is hoped that the more realistic basis for population sampling in this programme will provide more realistic and applicable data. This collated research information will then be assessed in the light of current vehicle engineering practices and equipment and the ergonomic implications on future vehicle designs will be reviewed.

CONCLUSIONS

The use of minibuses to transport disabled and elderly people is on the increase in the UK. These types of vehicles, if designed with the end users needs in mind, can provide an important and complimentary service to large

buses and private cars. The study described in this paper seeks to collate current data and new information to provide the basis of an up to date economically feasible ergonomic specification for minibus design. If this guideline specification can then be implemented then the standard of service provided by these vehicles can be improved. Perhaps more importantly the use of these vehicles can be maximised to provide improved transport options for the disabled and elderly user.

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Table 1 : Commonly Reported Problem Areas

TRANSPORT ORGANISER	DRIVER/ATTENDANT	USER	VIDEO ASSESSMENT
Seating Capacity	Manoeuvrability of vehicle	Difficulty in use of steps	Difficulty in use of steps, height and configuration
Step Access	Seat Comfort	Insecurity on lift	Insufficient/ Poorly designed handrails
Ride Quality for Passengers	Ride Quality for Passengers	Ride Quality	Knee-room
Aesthetics	Storage of Walking aids	Knee-room	Space requirements for wheel chair restraint fixing
Poor Vehicle Quality	Lift Operations in Cold Conditions	Noise	Doorway Headroom
Heating and Ventilation	Obscured Driver Vision		Sharp intrusions in doorways
Poor ancilliary equipment design	Installation of wheelchair restraint systems		

Table 2 : Form and Coverage of Ergonomic Specification

Access	• Number of Location of Doors • Doorway Dimensions • Dimensions of Steps (and Ramps) • Wheelchair entry and lifts • Manoeuvring space between doorway and passenger compartment • Provision of Handrails and Handholds • Vehicle interior height • Gangway discussions • Access and means of emergency exit
Seating	• Seats (height, depth and provision of support) • Ease of interchanging seating • Seat spacing for different types of layout
Safety	• Restraint for seated passengers • Restraint for wheelchair passengers • Seat anchorages • Storage of lifts, ramps and other equipment when not in use • Hazardous projections in vehicles and on equipment • Door control and locks
Operating Conditions	• Overall vehicle dimensions • Ride and accelerations • Environmental conditions (heating, ventilation and lighting) • Surface materials • Flexibility of interior layout (including seating and restraints) • Provision and location of ancilary equipment related to user requirements • Access of aids and wheelchairs • Stowage of aids and wheelchairs

FIGURE 1: A Typical Minibus Conversion - A Freight Rover Sherpa Converted by Dormobile.

DIFFICULTIES EXPERIENCED BY DISABLED MOTORISTS IN THE WEARING OF SEAT BELTS

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Difficulties Experienced By Disabled Motorists In The Wearing Of Seat Belts

Background to the Project

For many years the Government of the United Kingdom have sought to encourage drivers and front seat passengers of motor vehicles to wear a seat belt in order to reduce the possibility of serious injury or death if the vehicle was involved in an accident. The campaign of persuasion was not wholly successful and in July 1982 the Motor Vehicles (Wearing of Seat Belts) Regulations were approved and they came into effect at the beginning of 1983. They stated that all motorists, with a few specific exceptions, were expected to wear a seat belt. One of the exceptions to the general rule stated "the holder of a valid certificate in a form supplied by the Secretary of State, containing the information required by it, and signed by a registered medical practitioner to the effect that it is unadvisable on medical grounds for him to wear a seat belt shall be exempt". The Transport Act 1982 provides for certain groups of disabled people to be exempt from the payment of a medical fee when seeking a certificate from a general practitioner in order to gain exemption from the Seat Belt Regulations.

The Royal Association for Disability and Rehabilitation (RADAR) supported seat belt legislation as part of our function is to prevent disability. However, another of our objectives is to ensure that disabled people are able to be as independent as possible and whilst supporting the compulsory wearing of seat belts we were anxious to ensure that people who were unable to wear a seat belt but were still able to drive were not effectively banned from driving because they were unable to obtain an exemption certificate. Our anxiety was heightened by a document by the Medical Commission on Accident Prevention entitled Medical Aspects of Exemption From Seat Belt Wearing : Guidelines for Practitioners. The Commission concluded that "the available medical evidence showed that a person fit to be in control of a vehicle is fit to wear a seat belt". This extremely contentious statement was followed by another which stated "few, if any, passengers will require certificates of exemption because they will usually have the option of travelling in the rear seat".

Anybody with detailed knowledge of the mobility difficulties faced by many disabled people will be aware that some disabled people, who may experience difficulty in wearing a seat belt, would be physically incapable of getting into the back seat of a car. For example, many models of cars in the UK have only two doors and although the front seats can be tilted forward the

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space available to reach the back of the car requires the passenger to possess the agility of a circus acrobat. Even where cars have four doors the rear compartment frequently has very limited leg space and would be totally unsuitable for people with arthritis or similar disabilities. RADAR was therefore faced with the dilemma of wanting disabled people to wear seat belts if possible but for them to be granted an exemption where necessary, while at the same time we believed the advice being given to medical practitioners was unsound.

RADAR took its anxieties to the Department of Transport and recommended that a research project should be undertaken with the following objectives:

1 to seek ways of ensuring that as many disabled motorists as possible are able to wear seat belts by designing and, where possible, producing adaptations to seat belts to meet particular and general needs;

2 to examine the Medical Aspects of Exemption from Seat Belt Wearing : Guidelines for Practitioners and to assess whether they are adequate;

3 to examine the Motor Vehicles (Wearing of Seat Belts) Regulations 1982 and to comment on them in the light of the other results of this project;

The Department of Transport accepted RADAR's proposal and agreed to provide 100% funding for it. Moreover, they agreed to co-operate in the establishment of a steering committee to oversee the project and assist the research officer. The success of the project so far has, to a large extent, been due to the active support and encouragement which The Royal Association has received from the Department of Transport.

Methodology

The methodology for the project was as follows.

1 A literature search was conducted to see whether previous or current research was pertinent to the Project.

2 Hospitals, voluntary organisations, seat belt manufacturers and other bodies were contacted and a number were visited by the researcher.

3 Information was sought from a number of European countries to discover whether they made any special arrangements for

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disabled motorists who experienced difficulty in wearing seat belts. We directed our enquiries to the relevant Government Department and where possible sought comments on their replies from an organisation representing disabled people in each country.

4 A questionnaire was distributed to 2550 disabled motorists who had indicated they were experiencing difficulty with their seat belts or who had sought an exemption certificate. As most of these people were known only to the Department of Transport the letter and questionnaire were distributed by the Department inviting people to return the questionnaire to RADAR. About 900 questionnaires were returned and which will be discussed below.

A rig was designed and built to test the ability of disabled people to use a seat belt and to see if certain aids would help. It was displayed at an exhibition which attracted a large number of disabled people with mobility problems.

Information was obtained on commerically available aids which could assist disabled people to use seat belts and provision was made in the original research budget to enable such aids to be distributed as appropriate to respondents who had indicated they were experiencing difficulties. I should stress again that our primary objective was to enable disabled people to wear seat belts rather than simply find excuses why they should not.

As well as the commercially available accessories arrangements were made through another part of RADAR to enable specific adaptations to be designed and made to suit particular people.

Results

The project is not due to end until the Autumn and therefore the following results must be regarded as provisional. I should be surprised if there are any major changes but there may be minor ones. Let me deal first with the results of the questionnaire.

Questionnaire

The questionnaire asked 24 questions and sought the following information:

Sex of respondent;

Nature of disability;

Type of car used and frequency of use;

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Type of seat belt used and whether it had been modified; and, if so, how;

Difficulties experienced in using a seat belt as either a driver or a passenger;

Had they tried to obtain an exemption certificate and, if so, with what result;

Did they experience difficulty in getting into the back of a car;

Would they welcome free assistance in resolving their seat belt problems.

2550 questionnaires were distributed of which 911 were returned satisfactorily completed. Almost 100 were returned uncompleted because the addressee was deceased or had moved to a new address. 35 questionnaires were returned inadequately completed and they were excluded from analysis. Almost twice as many men returned questionnaires as woman. 438 repondents stated they did not require any further assistance and 449 indicated they would like assistance with their seat belt problems. 74 people commented in negative terms about the medical assessment, the seat belt laws, charges for exemption certificates, etc. 46 people reported either not wearing a seat belt or wearing it in an unapproved manner (eg. tucked under their arm or sitting on it) although they did not have an exemption certificate.

Problems in Wearing Seat Belts

Disabilities have been analysed according to the World Health Organisation definitions but more general grouping revealed that the most common disability was arthritis and related diseases which was mentioned by 245 respondents. 85 people suffered from some form of arterial disease and 68 experienced respiratory difficulties. In many cases the clinical label of a disability is not particularly helpful in determining the difficulty which the person is likely to experience although there are some correlations. Perhaps a more useful table is the physical difficulties which people experienced. We thought that some people who were of below average height might experience difficulty with the seat belt catching across their neck and 7% of respondents were under 4 feet 11 inches.

740 respondents had attempted to obtain a medical exemption certificate but only 197 had succeeded in doing so (26.6%). This low rate of success may be one of the reasons why a considerable number of respondents were critical of medical practitioners who had examined them. The following quotes give a flavour of the responses we received.

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"the doctor who examined me was without a doubt the most ill-mannered and unsympathetic doctor I have ever had the misfortune to consult in the whole of my life - and I have seen scores"

"doctor absolutely refused to tell me (the reason why he would not issue an exemption certificate) and when I asked why, told me - rudely in my opinion - that he didn't have to tell me and didn't intend to do so. This enraged me"

Obviously people whose doctors failed to give them what they wanted, in this case an exemption certificate, are likely to have a negative view of their doctor. However, perhaps it does show that in any system medical practitioners need very clear advice on how to deal with disabled people who approach them.

We sought information regarding the difficulties people face in wearing a seat belt either as a driver and a passenger and the results were as follows:

Difficulties expressed by disabled motorists

Difficulty	As Driver		As Passenger	
	No.	%	No.	%
1 Cannot reach anchorage point	66	13	34	11
2 Seat belt tight across chest; breathing restricted; painful	88	17	40	13
3 Cannot fasten/unfasten seat belt	80	16	104	35
4 Difficulty pulling seat belt across	26	5	11	4
5 Seat belt tight across shoulder; ribs; painful	35	7	14	5
6 Seat belt tight across neck; throat; ribs; painful	40	8	36	12
7 Lap belt uncomfortable across waist; hips; thighs; painful	24	5	12	4
8 General discomfort; inconvenience; nuisance; restricts body movement; restricts angle of vision; prevents reaching of controls; causes spinal pain	144	29	49	16
TOTAL	503	100	300	100

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A number of people reported more than one difficulty and others indicated a difficulty but did not wish to receive help in resolving it. It must also be remembered that our methodology was designed to attract those experiencing difficulties rather than the majority of disabled motorists who experience no difficulty.

The above gave us the appropriate information to enable us to analyse the difficulty experienced and to seek solutions to them. This led us to the next phase of the project which was offering practical assistance to disabled motorists.

People who are unable to reach their seat belt are often those who are unable to turn their body to enable them to do so. An attachment to the belt, so they do not have to stretch too much for it, may solve the problem.

Some people lack the physical strength to pull the belt across their chest and if they can pull it across they find the pressure on their chest painful. Belts can be modified by the manufacturers to reduce the retraction force. Not only does a decrease of force make the belt easier to pull but it also makes it easier to insert the tongue of the belt into the buckle. However, the belt needs to be very close to the chest if it is to be effective when needed.

A number of commercially available aids were available which appeared to offer solutions to some of the problems expressed. They were obtained and sent to disabled people where it was thought that they may solve their problem. These included devices to enable people to reach a seat belt more easily or to lower the anchorage point so the belt did not cut across their neck. A further aid was a quick release lever which had been designed by the research officer, Mr John Isaacs.

It was necessary to assess whether the disabled motorists found the aids helpful and this was done in two ways. Every person who was sent an aid was also sent advice on how it should be fitted and a questionnaire on its suitability. These questionnaires are still being returned so it would be premature to analyse them yet but a preliminary analysis suggests that many people have found them helpful. The other method used was assessing disabled people on the rig mentioned earlier. A simple attachment to the seat belt in the recoiled position enabled people to reach it more easily and many visitors to the Mobility Roadshow, where the rig was demonstrated, indicated that they found it useful and would probably purchase one for their own car. Another aid, the Clever Clip, prevents the seat belt recoiling as far as possible when being worn and therefore eases some of the pressure across the chest. This also proved popular but evidence was obtained that some people were tempted to fit it incorrectly and in the event of an accident it could render the

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seat belt less effective than it would otherwise have been. It was interesting to note that very few people appeared to have known of the accessories which were readily available in car accessory shops.

The rig was also used to assess whether people found it easy to pull the seat belt across their chest and the amount of pressure they could exert to carry out this operation. It was also through use of the rig that it became apparent that those who experienced difficulty in inserting the tongue into the buckle, and many of them were totally unable to do so, were able to do so when the belt pressure was reduced. It would appear therefore that the amount of pull on a belt is instrumental in determining whether a person is able to fasten it.

There are several ways to release a seat belt and the common denominator of most of them is that they require considerable dexterity. The easy release lever, mentioned earlier, helped to resolve this problem for most people. Although the results from the test rig are extremely interesting they need to be treated with some caution as only 80 disabled people used the rig. However, the questionnaire data from people who have used the various aids and accessories supports the evidence provided from the rig.

Having designed the release lever it was necessary to see if it met the needs of the initial respondents. At this point, however, we were conscious that some people were fitting accessories incorrectly and with such a crucial piece of equipment as the release lever we thought it vital to ensure correct fitting. One aspect of RADAR's work is that we have scattered throughout the UK over 90 Rehabilitation Engineering Movement Advisory Panels (REMAP) which are composed of engineers, doctors, occupational therapists and other professionals who give their time free of charge. We employ a number of regional organisers which assist these voluntary panels and through the regional organisers we arranged for the levers to be fitted by engineers to the respondent's own car. Engineering knowledge was necessary because the basic release lever would not fit automatically to every buckle and needed to be adjusted. Initial indications are that the lever is a huge success but once again we are seeking feedback from users.

Under the project we have been able to assist a large number of disabled motorists but there are some for whom we can think of no easy answer. The research officer is currently visiting a selection of these people to determine whether an aid or accessory could be designed to meet the particular need of individual disabled people. It will undoubtedly be possible to

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assist some but early indications suggest that some people are perfectly capable of driving but are unable to use a seat belt and it seems sensible that such people should be given an exemption certificate with the minimum of fuss. We have not yet defined precisely which group of people fit into this category but expect to do so shortly.

Experience Overseas

Enquiries were made of twelve European countries regarding their seat belt legislation generally and their attitude towards exemptions for disabled people. Of the twelve countries, eleven replied. Finland being the exception. Replies were received from Austria, Belgium, Denmark, France, Germany, Netherlands, Portugal, Spain, Sweden, Switzerland and Yugoslavia.

None of the countries claimed to have made an investigation into the question of seat belts for disabled people and Yugoslavia were particularly interested in the UK work. In nine countries exemption is granted on medical grounds certified by a doctor or other named official. In seven countries exemption is granted to small people, usually those under 150 cms (4 feet 11 inches). In six countries exemption is granted to drivers engaged in low speed journeys involving frequent stops for delivery of goods. In five countries taxi drivers are exempt from wearing seat belts. The full details regarding provision in the various countries will be shown in the final report.

Conclusions

It will be apparent from the paper that it is too early to draw final conclusions from this project but it is possible to make some preliminary observations. The first is that most disabled motorists are able and willing to wear seat belts. However, a small minority do experience difficulties in reaching their seat belt, in pulling it across their chest and in fastening and unfastening it. Others experience discomfort because of the pressure of the seat belt on their chest which may affect surgical wounds or restrict breathing. It seems probable that most can be assisted through commerically available accessories although others will need the seat belt to be altered specifically for them. However, some people, who are competent drivers, are unable to use seat belts, despite any help which may be available, and we would argue that such people do require an exemption certificate.

In the UK a significant minority of disabled people have experienced difficulty in persuading their doctors they need an exemption certificate and although, in many cases, the doctor

.../...

appears to have been right in refusing an exemption certificate. In other cases, the decision appears to have been exceptionally harsh. Clear guidelines must therefore be given to medical practitioners and these guidelines must be based on actual data rather than general suppositions.

There is considerable ignorance regarding the problems which disabled people face and we hope that our project will help resolve this to some degree. However, there is also ignorance regarding the accessories which are available and it has been agreed that RADAR should publish a short booklet giving details of them together with the advantages and disadvantages associated with each accessory. I would suggest that a recognition of the need to provide disabled people with accessories, but to also recognise where an exemption should be issued, would go a long way to resolving the problems which disabled people experience in relation to seat belts.

Disclaimer and Acknowledgement

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THE BLIND: WHICH OF THEIR PERCEPTUAL ABILITIES AND AIDS ALLOW SIGNIFICANT MOBILITY?

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The blind: Which of their perceptual abilities and aids allow significant mobility?

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Eighty per cent of the blind are not independently mobile out of their own residences at present. But recent psychological research - on layout perception, tactile illustrations and spatial imagery in the congenitally blind - provides grounds for expecting many of the blind could take advantage of aids for independent travel.

Two kinds of mobility aids are especially important: graphic aids (raised-line maps and pictures) and electronic aids (such as hand-held scanners). Both are concerned with awareness of the layout or arrangement of surfaces in the environment. The elements that prove significant and successful when blind people make raised line pictures and maps of their surroundings may tell us what could be highlighted or emphasized by building and pathway designers, to be maximally useful to hands holding scanners.

Consider first spatial perception and outline drawing by the blind.

Recent research, summarized in Kennedy (1983, 1985), in psychology has asked what kind of geometry characterizes the congenitally blind person's sense of the surroundings, and

what geometric rules of form they use to draw or diagram their environment in pictures and maps. The basic findings in this research are these: first, the typical blind person is aware of his or her perspective on the environment. The directions and distances of objects follow the principles of convergence which govern the sighted person, albeit the blind person's apprehension of spatial relations is not as detailed as the sighted person's. If a blind person is asked to show directions between objects in a small space (a table top), he or she can swivel the wrist to point to close by and further objects, and can adjust for hand movements that take the pointing hand near or far from objects dotted around the table. On a larger scale, like a room, the blind person can orient to objects to show an awareness that more distant objects subtend a smaller angle. On a street, the blind person is aware that the tops of buildings are directly above from a vantage point at the base of the building, and the top is at an acute angle for an observer across the street, and a lower and lower angle as the observer walks away from the building. In a series of pointing tasks in research with J. Campbell, skill at comprehending convergence with distance has been shown in congenitally blind subjects (Kennedy & Campbell, 1985). In interviews with congenitally blind people questioned about pointing to corners and tops of tall buildings, all the subjects questioned gave clear, unambiguous verbal indications of awareness of convergence of directions with converging distance.

Comprehension of principles of perspective and convergence in the real-world setting does not transfer immediately to graphic

representations. Even sighted children in Western technological cultures only master perspective drawing slowly, in stages (Willats, 1981). Similarly, the blind cannot be expected to represent their real-world awareness in first use of graphic pictures or maps. There is some development to be expected. However, research indicates that even first use of a graphic spatial representation by the blind can be impressive.

The results of research on blind people drawing pictures indicates considerable form perception abilities, and drawing or representational abilities that develop much as they do in the sighted child. The blind use lines to stand for edges of flat surfaced objects, corners, and also for the boundaries of curved objects (as in drawing a circle for a ball and a rectangle for the sides of a glass or tumbler). In short, the blind are aware of the outline of objects. Features such as overlapping or occluding edges are evident to the blind. Abrupt changes in depth or slant at corners or steps can be drawn in outline by the blind.

The ability to represent a complex shape develops during the blind person's childhood and teenage years, it seems only slightly delayed compared to the development in the sighted child. Blind teenagers generally have been found to be able to draw objects from several vantage points, to show awareness of multiple faces of an object and to indicate what is front and what is back. The ability to coordinate the various faces, retain proportions and connections, and to indicate depth and slant is what develops through small phases in teenage years. In adulthood, blind adults have been shown to recognize various kinds of perspective drawings, and

to appreciate which are likely to transform rectangular surfaces into converging forms because of the vantage point.

The research on apprehension of the geometry of the surroundings and the principles of shape representation in a graphic medium indicate important, useful abilities in the blind. The abilities need sharpened and improved, but they do not need to be established from foundations upwards. A spacious, shape-filled three-dimensional world with a mobile vantage point that modifies the perspectives of near and far objects is the normal consciousness of the blind, and that awareness can express itself and learn from two-dimensional graphic versions of the three-dimensional world.

It is also clear (Campbell, this volume) that hand-held scanners, especially sonar models, can be employed to pick out crucial details, distances, steps and obstacles by the blind. How can the opportunity to employ such scanners be improved, given the knowledge gained in the research on perception and representation?

Campbell points out that one complaint about some varieties of scanners is that they are too general. The heart of this problem is that scanners can provide superfluous information. The scanner can reveal a great deal of information, but much of it is redundant. The user is especially keen to find the functional architecture of his or her surroundings, and thus wishes to quickly find the steps, corners, paths, doors and obstacles, but wishes to avoid spending time on the uniform expanses between these key features of layout.

How can the urban designer assist someone with a scanner? Note that form apprehension in the blind involves the abrupt changes in depth and slant at corners and edges. If these can be made readily detectable by scanners, layout perception will be aided. At edges of carpeted metal or stone steps, reflective material would be helpful to the scanner (as well as to those with low vision). At doors, reflective tape bands or paint would assist the scanner searching for exits and entrances. At doorways, reflective strips that only become evident once the door is open (or closed) would be beneficial. In complex hospital corridors, urban walkways or transit connecting centres, floor or ceiling strips of reflective material can indicate corners, and can also be used as continuous guides to destinations.

Scanner reflecting strips need not be obtrusive. They may be uniform in colour with surroundings, but be more saturated or matte than adjacent paint. They can be on poles much like "cats-eyes" or reflective stanchions for auto drivers. They can be brief, like strips on bus stairs, or strips on bus or tram poles for passengers to grip when alighting or entering. They can be made conspicuous, in which case by strong contrast they can be helpful in dim illumination or to low vision people. They may be already conceptually a part of design, since rough patches rather than smooth flooring is characteristically added to edge of subway platforms. It is only necessary to ensure that the roughness contains particles oriented to provide a strong echo to scanners of passengers arriving at or leaving the car.

In principle, the sonar user wishes to find the foundational architecture of his or her surroundings, and strips outlining key changes in surface layout would emphasize the skeleton that it is most necessary to know.

In conclusion, recent psychological research indicates an awareness of the essential principles governing the transformation of space available at vantage points. This kind of awareness is the basis for perception of the outlines of objects at several scales (room-size or street-size). It can be represented by the blind graphically. It can be apprehended via scanners, and ease of apprehension could be improved by designing reflective materials into the artificial environment.

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SENSORY 6*: ULTRASONIC MOBILITY AID FOR THE BLIND

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I. OVERVIEW

E.L. Bryenton & Associates, Inc. and **BRY**tech* have developed a new hands-free ultrasonic electronic travel aid (ETA) for the blind. It is called the Sensory 6*. The goal of this paper is to introduce the Sensory 6 and to describe the process which culminated in its development.

Before presenting the Sensory 6 some background information is useful to clarify what it is intended (and is not intended) to do. Accordingly, we first present a review of the purposes of ultrasonic ETAs and describe where the Sensory 6 fits within that scheme.

Although the early design phases of the Sensory 6 are presented, we have emphasized the findings of our most recent field trial. The field trial is particularly relevant here because it reflects evaluations of the Sensory 6 by blind people who used it for day-to-day mobility.

ULTRASONIC ELECTRONIC TRAVEL AIDS

The main function of any ultrasonic ETA is to extend the user's perception to include the environment beyond body space. Ultrasonic ETAs extend the user's space by using the principle of ultrasonic radar. Essentially, high frequency ultrasonic signals are emitted. When an object is present within the functional range, a portion of the sound waves is reflected back to the ETA. Receiving transducers detect these returned sound waves and translate them into signals that the user can then interpret.

Being able to sense distant objects can affect the lifestyle of the blind user in several ways. Of most interest to this conference are mobility and travel related functions. The most commonly discussed applications of ETAs to travel are: 1) To help the user locate obstacles, i.e. supply the information necessary for a user to find a clear path; 2) To serve as an environmental sensor, supplying as complete and rich a view of the environment beyond a person's body space as possible (see Brabyn (1985) for a recent discussion). An environmental sensor can be used to locate obstacles, but generally its more important function is to help the user develop concepts of space. These concepts can be applied to travel related tasks.

These two applications represent quite different functions for the user and have distinct consequences for the design of the aid. For example, a successful environmental sensor requires a wide beam in order to present a large section of the environment at one time. For similar reasons, the signals presented to the user should contain as much information about the objects within the space as possible: size, shape, texture, distance, and location, for example. On the other hand, an effective obstacle detector may have a narrow receptive field and merely code presence and location of objects within its field.

When we at E.L. Bryenton & Associates began discussing the design and manufacture of a hands-free ETA, we assumed that what was wanted and needed for travel was an affordable environmental sensor. In developing the Sensory

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* **BRY**tech and Sensory 6 are trademarks of E.L. Bryenton & Associates

6 we began by soliciting opinions from both Orientation and Mobility (O & M) specialists and from potential users across Canada concerning what was wanted and needed in a travel aid. We found, contrary to our expectations, that users and O & M specialists agreed that a hands-free obstacle detector would meet the travelling needs of the blind more efficiently than would a hands-free environmental sensor. Both groups perceived information not directly related to travel as a hindrance rather than a help.

The design of the Sensory 6 reflects our decision to create a dedicated travel aid modelled on an obstacle detector.

Once we had determined the general concept of the design the process of realizing the design goals began. Before describing the Sensory 6 and the field trial it is worthwhile to note the procedures which led to the prototype implementation.

DEVELOPMENT PROCESS

There were six major phases in the development process, from needs assessment through Field Trial response. The steps are described below:

(1) Assessment of Users' Needs. We assessed the users' needs and interpreted them in terms of design criteria. This stage helped convince us that what was needed was a hands-free travel aid modelled on an obstacle-detector. This stage also verified that basic skills for safe ETA travel include obstacle detection, object location, distance judgment, and shorelining. (2) Performance Feasibility. We conducted pilot tests on commercially available ETAs and confirmed that an obstacle detector could be used satisfactorily to perform the requisite travel-related tasks. (3) Prototype Design. The above two stages gave us enough information to focus development and to create a prototype. (4) Design Evaluation and Modification. We refined the prototype through several iterations and several formal and informal testing phases. At each stage we incorporated improvements in function or design. When we reached a formal testing stage, the model performed well on travel-related tasks and several further improvements in design were made. (5) Design Evaluation by Field Trial. We distributed the resulting prototype to blind participants who were given instructions concerning how to use the Sensory 6 and we asked them to use it daily over a period of weeks. We also distributed a User Guide in both print and in audio-cassette format. We solicited reactions and comments on the Sensory 6, the training programme, and the documentation both from the blind participants and from the O & M instructors who directed the training. (6) Design Response to Field Trial. We incorporated actionable items into a new model, resulting in the Sensory 6 design presented here.

In this paper we present a description of the features and functions of the Sensory 6 as they affect the user, followed by a description of the procedure used in the field trial and the findings obtained.

II. SENSORY 6 DESIGN

The Sensory 6 is a hands-free ultrasonic ETA. Transducers located in the lenses of the eyeglasses send out ultrasonic waves which reflect off of objects in their path. The returned waves are received and translated into audible sounds presented to the user through a stereo headset.

The Sensory 6 has three components: a pair of eyeglasses supporting transducers which send out the ultrasonic signals and receive the echoes; a base unit which houses the controls, power, and electronics; and a lightweight stereo headset to deliver the auditory information to the ear. A small flexible cable containing four separately shielded wires connects the base unit to the transducers and headphones. Auxiliary equipment is also available which allows an assistant to hear the sounds generated by the Sensory 6. Details concerning the components are presented below:

SENSORY 6 COMPONENTS

(1) Base Unit

(a) The Sensory 6 is powered by a rechargeable battery pack which forms part of a base unit. The battery pack is a 5V DC rechargeable unit with an eight hour reserve, normally sufficient for one day's use. This base unit also contains the electronics that control the functions of the Sensory 6. The entire case weighs less than 300g and can be worn clipped to a belt, around the neck or shoulder on the strap, or carried in a shirt pocket. Spare rechargeable battery packs are available.

(b) Also located on the base unit are a volume control dial and a range setting switch. The range can be set at short (up to about 2 metres) or long (up to about 4 metres).

(2) Eyeglasses and Electronics

Standard eyeglass frames contain a transducer in each lens holder which sends and receives ultrasonic signals. The ultrasonic electrostatic transducers which are being used are about 2.5 cm in diameter and are designed to deliver a very narrow beam width at a frequency of 50 kHz. In the Sensory 6 the two transducers are operated alternatively so as to avoid cross-talk between channels and remove the possibility of confusion between left and right signals. Pulses at 50 kHz for 320 microseconds duration are fed to the transducers in the transmit mode at a repetition rate of 100 ms for each side. The unit is then almost immediately switched to receive mode for a period dependent on the setting of the range switch. For the short range (2 metres) the receiver is enabled for 12 milliseconds and on the long range (4 metres) the receiver is enabled for 25 milliseconds.

The signals are transmitted in a narrow conical beam approximately 8 degrees in width. The two beams are arranged so that their edges overlap and there is no dead spot in the middle. The narrow beam yields essentially the electronic equivalent of a very long cane without the encumbrance of a physical object.

If a return signal is detected, indicating the presence of an object within the range of the Sensory 6, a voltage controlled audio oscillator (VCO), is keyed on. The voltage fed to the oscillator is proportional to the flight time of the echoed signal, thus the audio frequency delivered by the oscillator is proportional to the range of the object. If a return signal is not detected, the VCO remains silent. The output of the VCO is fed via an audio amplifier to the appropriate left or right headphone. The VCO is multiplexed between the two channels and delivers audio pulses of just under 100 ms. The frequency range is from 190 Hz representing 4 metres (12 feet) to 2920 Hz for 25 cm (1.0 feet).

(3) Headset

A lightweight stereo headset connects to the base unit to allow the user to hear the tones as they are generated from the transducer system.

(4) Auxiliary Package

An auxiliary package consisting of a headset and connector is available to allow an observer or sighted guide to hear the sounds generated by the user's Sensory 6.

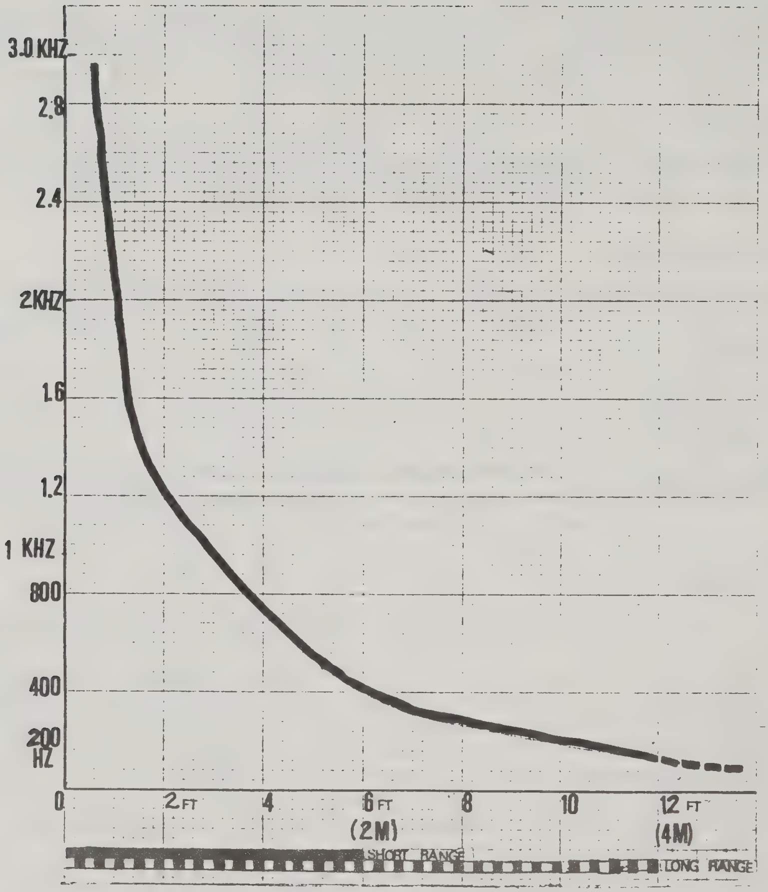
SENSORY 6 FUNCTIONS

Audible tones are produced by the Sensory 6 when an object is present, and they are heard as electronic tones. The Sensory 6 operates as a warning device. It is silent until an object is detected. This scheme gives the user full use of the ambient auditory environment, and it facilitates attention to Sensory 6 signals.

Near objects yield higher-pitched sounds than objects which are far away. (See Figure 1 for frequency as a function of distance for both long and short range.) The decrease in pitch with increased distance is a "natural" sound correspondence. For example,nearer objects sound higher pitched. The frequency of sounds produced by the Sensory 6 is constant for an object at a given distance regardless of range switch setting (see Figure 1). For the user this constancy means an object at a given distance within the range chosen will create a sound at a given frequency whether long or short range is used, hence there is no need to transpose information across the two ranges.

Location in the horizontal plane is coded by the stereo effect which results from having two transducers with slightly overlapping fields (see Figure 2 for a diagram of the polar pattern). As can be seen in Figure 2, an object located in the Sensory 6 field left of centre will be detected by the left transducer only, resulting in a signal to the left earphone of the headset. If the object is in the area around midline, where the fields overlap, signals will be sent to both earphones. Similarly, an object located in the right field will produce a sound in the right earphone only.

Also seen in Figure 2, is the narrow receptive field of the Sensory 6, which is in keeping with our obstacle-detection model. As indicated in our early research, users can easily locate an object precisely by making slight scanning motions with their heads.

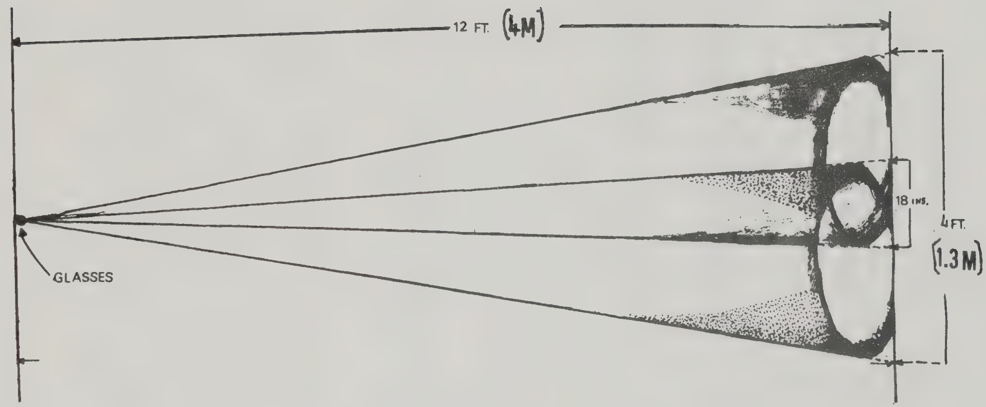


Audio frequency as a function of distance.

Figure 1

BRY TECH
23.6.86.

5



Polar Pattern

Figure 2

BRY TECH
SENSORY 6
23.6.86.

In summary: If no object is present the Sensory 6 is silent. When an object is detected the user hears electronic tones. The object's distance and direction are immediately available and are readily interpretable by the user. Further detail, such as size and shape, can be obtained by scanning the area around the object of interest.

III. FIELD TRIAL

A prototype of the final design was field tested, and the findings are presented here. For the field trial, Sensory 6 units were distributed to blind users with little or no residual vision. These users underwent a training course followed immediately by an opportunity to use the device over a period of weeks. The two purposes of the trial were: first, to get input on the performance and hardware of the Sensory 6 when used regularly under a variety of conditions by a diverse group of people; and second, to solicit feedback concerning the supporting documentation. The supporting documentation consisted of a training manual, training programme, and a user guide.

Before discussing the findings from the field trial and how they were incorporated into the Sensory 6 design, a few words are in order describing the procedure used.

PROCEDURAL DETAIL

Prior to training or recruiting the blind participant, fourteen O & M instructors were exposed to the training programme and reviewed the training procedure. Each O & M instructor then recruited either one or two blind participants. Each blind participant completed a series of lessons supervised by an O & M instructor.

The training programme included at least five lesson-sessions of about 45 minutes for each participant. The lessons included practice in a set of basic skills related to mobility plus a preliminary exercise included with the first lesson. The preliminary exercise served as an introduction to the Sensory 6 and permitted the participants to map out its effective field. The fundamental mobility skills practiced under supervision were: 1) distance judgment, 2) obstacle and object detection, 3) shorelining, 4) detecting overhangs, and 5) landmark identification. Landmark identification was included to enhance awareness of landmarks which would be otherwise inaccessible (or unnoticed) to the users.

Fifteen blind people from Halifax to Vancouver participated in the field trial. (Two of them did not return their questionnaires in time to be included; however, their other comments were incorporated.) All participants were recruited by O & M specialists in their respective geographic areas. Participants were subject to the restrictions that: 1) they be mobile and 2) they have no functional residual sight. Participants ranged in age from 18 to 58; all but two were male. Blindness was a result of a variety of causes.

Participants were requested to use the Sensory 6 at least once each day for the duration of the field trial. The trial required 30 days, including the training sessions. Because of individual needs and motivations, the par-

ticipants were free to use the device as frequently as they chose each day. The duration of each use was also left to the participant.

Participants were asked to keep a log and record any comments or observations. We felt the patterns of use would be of interest particularly as they were free to use the Sensory 6 as little or as much as desired. They were also asked to complete a set of structured questions. In addition we had the participants time a frequently-travelled route at the beginning of the trial, without using the Sensory 6. At the end of the 30 days we asked that they repeat the route using the Sensory 6 and to record the time to travel as well as any difference in landmarks used.

MAJOR FINDINGS

The field trial provided valuable information on which to base modification to the prototype to create the production model.

First and foremost, although we had cold-tested the prototype in the laboratory, we discovered that the prototype did not tolerate the sudden changes in temperature encountered when taken from indoors to outdoors in the middle of a Canadian winter. (See operating conditions in the results section more detail.) The Sensory 6 has been re-designed to eliminate the problem. The malfunction induced by temperature did affect many of our prototype units and, consequently, the amount of time logged was reduced and answers to some of the questions coloured. Nevertheless, the remaining data yielded much useful information, and are presented here.

In presenting the findings we have emphasized those data which yielded actionable items. These have been grouped into major sections which can be loosely described as: hardware related (operating conditions and components), function related (functions and time to travel), population related, and related to the literature provided with the Sensory 6 (User Guide and Training Manual).

1. Operating Conditions

The field trial covered a large geographic area in part because we wanted to test the prototype under a variety of weather conditions: wind, rain, etc. Fortunately, circumstances led us to conduct the field trial in mid-winter. Winter testing yielded information concerning the temperature sensitivity of the prototype, and also concerning the ability of the Sensory 6 to detect winter objects.

Looking at hardware first, we found that when the prototype was taken outdoors into the cold, a number of the units produced a high-pitched intermittent "beep" in one or both earphones, indicating an object near the user when there was no object present. The difficulty was traced and has been corrected. As a consequence of this experience, we are more firmly convinced than ever of the need for field testing to complement laboratory tests.

The second consequence of winter testing was that users found that the Sensory 6 is quite effective in detecting snowbanks. Detecting snowbanks was

used both for shorelining and for locating laneways for orientation. A further benefit was that the traveller could remain on the clearest part of the sidewalk and use the Sensory 6 as a guide without having to approach the more slippery edges.

2. Components

Our design goal emphasized simplicity. Participants appreciated a device which is easy to use and simple to operate. The results suggest that uncertainty, too much equipment, or difficulties in organizing the components will reduce user satisfaction. Simply put, anything that can go wrong, will; and satisfaction with the device will suffer accordingly.

i. Battery Charger and Operation

Users uniformly found the battery charger easy to use. Similarly the operating controls, the On/Off/Volume dial and the range switch, were easy to operate.

As a result of a few comments, however, the switch markings have been improved. Users felt that durable tactile markers help considerably when learning to use a new device. Tactile confirmation that switches or dials are set as intended helps make the user more comfortable with the aid and reduces time lost while verifying settings.

ii. Cables

The components of the prototype were connected with individual cables. One length of cable connected the base unit to the headset. That cable split to carry the sounds to each earpiece. A second cable connected the base unit to the eyeglasses.

Users disliked the cables on the prototype which connected the base-unit to the headset and the base-unit to the eyeglasses. We initially felt that although the two sets of cables on the prototype could tangle, the problem was not a serious one. In fact, the cables tangled quite readily and were very difficult, and occasionally frustrating, to untangle. Accordingly, the Sensory 6 was modified to incorporate all of the cables from the base-unit into one sheath.

Amalgamating the cables makes the Sensory 6 easier to use in two ways. First, it is easier to wear. Second, the user cannot inadvertently put the headset on backwards.

iii. Comfort

We recognized that comfort was very important in design, as people would be using the Sensory 6 for several hours at a time. Comments from the participants were responded to in the re-design. Accordingly, although the headband of the stereo headset still competes with a toque in winter, we have suggested that users bend the temple pieces to accommodate their specific head shape and have altered the nose pieces so that the unit can rest more comfortably on the nose.

3. Functions

We asked participants to record their comments as they went along throughout the trial. We also included two questionnaires, one to be completed after the initial training period, the other at the end of the trial. The first questionnaire was intended to capture early impressions of the Sensory 6 and the second to rate the prototype once some experience had been obtained. Although the temperature sensitivity rendered the absolute value of the ratings less informative, the information is still of considerable value when combined with the observations in the log.

In the first questionnaire people were asked if they found the sound system easy to learn (Yes or No) and to comment on the easiest and most difficult aspects. All respondents found the sound system was easy to learn. Of those who responded to the question concerning the easiest aspect to learn, 86% indicated distance judgment. These data were encouraging as one of the primary properties of the Sensory 6 is to allow distance judgments.

There was no consensus among those who responded to the question concerning what aspect of the Sensory 6 was most difficult to learn. This, too, was encouraging as it suggests individual differences determined what is difficult for each user rather than a general difficulty with the Sensory 6.

After having 30 days' experience with the device, participants were asked to rate their feelings about the performance of Sensory 6 on several functions and features. A five-point scale was provided where 1=bad, 2=poor, 3=fair, 4=good, and 5=excellent. The two properties which rated highest were "distance judgment" and "detecting obstacles". Distance Judgment received the highest rating, followed by Detecting Obstacles. The modal (most common) response for each was 4 (or "good"), representing over half of the responses.

These responses are encouraging as distance judgment and obstacle detection represent the two most important functions of the Sensory 6. These responses are also consistent with the participants' early impressions that the sound system is easy to learn and distance judgment is the easiest aspect to learn.

Next highest ranked were the other primary operating functions. In order of rank: "Detection of Overhangs", "Landmark Detection" and "Shorelining". These were followed by features relating to such factors as appearance, safety, and indoor and outdoor use.

Although we consider the cosmetics of any ETA to be very important, we have not discussed the rating of "appearance" in the field trial because the fabric covering the transducers was altered after the field trial to improve durability. The coverings dramatically affect the appearance of the Sensory 6 and we are confident that the improved covers are not only more durable but also look even better than those used in the trial. It seems reasonable to assume that ratings of the other features (safety and indoor/outdoor use) were seriously affected by the cold-weather malfunction.

Finally, the two features which received the lowest rating deserve mention. These were "Finding Small Objects" and "Comfort". The rating of the

feature "Finding Small Objects" was rated either 1 or 2 by all participants, indicating general negative agreement. The fact that the Sensory 6 performed less well on finding small objects is not surprising, given the nature of ultrasonic signals. However, we do have information from a skilled blind user of the Sensory 6 that a person can readily detect objects as small as a clothesline if the background is clear of objects.

The second feature which received a low rating was "Comfort". However, the range of responses was 1 to 4, reflecting a lack of general agreement. The recorded comments of the participants suggested that difficulty was caused by three main factors: 1) cables tangling, 2) nose piece not quite comfortable, and 3) the temples fitting incorrectly. These sources of potential discomfort were reduced.

4. Time to Travel

The records of time-to-travel produced some interesting findings. First, we incorporated the measure because we felt that, even if the participants reported that they would not explore new areas, this measure would reveal if the Sensory 6 allowed them to travel more quickly. The measure did not work out quite that way. As expected, it did show that users were able to use various poles and mail boxes that were previously unavailable as landmarks. Contrary to expectations, however, people did not show a marked decrease in time to travel. The comments made by the participants revealed why. As we might have anticipated, some of them had not practiced with the Sensory 6 over the route and hence were not familiar with the landmarks. In one case the user was so busy exploring the new landmarks that he could incorporate into future use, that it took him longer to complete the route. He reported later that with added experience he used the landmarks for travel rather than exploring and did indeed travel faster.

5. User Population

The original premise that the Sensory 6 is suitable primarily for those with no functional residual vision was supported. The Sensory 6 transducers cover the area where the lenses would normally be. Not surprisingly, four participants with some light perception found the Sensory 6 interfered with that vision.

6. User Guide

The User Guide and its audio tape version were designed to be standalone documents, i.e., they include enough information and examples for a user to explore the Sensory 6 without depending on another person. However, several people, both O & M instructors and blind participants, observed that initial use is made much easier if a sighted guide produces a rich commentary describing the objects and resulting signals as fully as possible. Accordingly, we have included that observation as a recommendation in the User Guide.

Participants appreciated the simple, understandable style of the Guide,

with minimal emphasis on technical detail.

Although the User Guide was designed as a stand-alone document, there is no reason to assume it would be read in isolation, hence participants were asked which format they preferred (Audio Cassette, Large Print, Regular Print, Braille, or Other). The participants' most widely demanded format was Audio-Cassette (100%), followed by Braille (chosen by 6 of the 11 respondants). The fact that Large Print was not chosen as an option is not surprising as these participants, and most potential users, could not make use of large print.

7. Training

The training programme was designed in co-operation with O & M instructors. It emphasizes functions directly related to travel and was well received. Its main function is to ensure that each user is familiar with the capabilities and operation of the Sensory 6. For the Field Trial, the programme ensured that each participant received supervised training in each of the skills most important for travel.

Blind participants and O & M instructors felt that the skills covered were indeed the most essential ones.

O & M instructors' comments were solicited concerning the training programme. Overall, there was a tendency for O & M instructors to request more detail than was provided in the step-by-step instructions of the Training Guide. This request was accommodated in the final version of the Guide.

Most of the blind participants kept records of the time spent training with an O & M instructor. In general, people who took less time to complete one lesson also completed the other lessons quickly. Almost all of the participants felt satisfied with the schedule although two indicated a preference for more training.

The data are consistent with the blind persons' and O & Ms' comments: the basic programme we have suggested is appropriate and both groups emphasize the importance of having a flexible schedule within each content area to accommodate variation in learning styles as well as motivation, time constraints, and current mobility and orientation skills.

8. User Satisfaction

After we had gathered all of the field trial data we followed up the trial with a telephone interview of as many of the participants as we could reach. The remaining participants were contacted by mail. In the interview and letter, we thanked people personally for their participation, informed them of how their comments led to improvements in the design, and asked them about their overall impressions.

All of the participants reached by phone were pleased to have a chance to talk about their impressions and to hear the results. Those who saw an ETA as a useful tool were very positive about the Sensory 6. We received positive comments concerning the elegance of design and ease of use. Several people

had given some thought to other uses to which the Sensory 6 could be put and suggested using it for the multiple-handicapped and for aiding people who had difficulty with cane skills.

CONCLUSION

The field trial gave blind users from Vancouver to Halifax an opportunity to use the Sensory 6 over an extended time. The results from the trial were used to make significant improvements in the Sensory 6 design.

Several events conspired to place the trial in the coldest part of the winter, which turned out to be very fortunate. We found that the prototype Sensory 6 developed a problem when taken from indoors to severe cold outdoors. As the difficulty did not occur in laboratory cold tests our premise, that field testing is necessary using actual environmental conditions, was reinforced.

The trial confirmed our belief, implemented in the design of the Sensory 6, that the unit should be easy to operate. We were able to define areas where operation could be made simpler. Specifically, multiple cables were eliminated, the possibility of reversing the headset was eliminated, and the controls are now more clearly marked.

User documentation is an often overlooked aspect of a new product. We confirmed the importance of documentation in our trial and enhanced the documents based on the comments obtained. The Trainer Guide has been revised to include more detail, as well as instructions concerning how to adapt the programme to individual needs. Although the User Guide retains its straightforward, easy-to-use format, some improvements have been made. Specifically, the components are described more fully and the beneficial use of a sighted assistant during training is discussed.

Finally, participants generally felt very positive about the Sensory 6 when interviewed after the field trial.

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APPROPRIATE TECHNOLOGY FOR THE DISABLED

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INTRODUCTION

It would seem self-evident that the resources, concepts and techniques of modern engineering should be applied to solving problems of communication, mobility and life support for elderly or disabled individuals. The result should be a marked improvement in the quality of life of the fortunate recipients. In fact, while there are certainly conspicuously successful devices such as cardiac pacemakers and powered wheelchairs, an honest assessment of the present situation shows that there is a vast array of examples where attempts to apply engineering technology in this area have failed dismally. In this paper I propose to discuss the situation, attempt an analysis of some problems arising, and set out methods by which they may be attacked.

EVIDENCE THAT A PROBLEM EXISTS

Signs of a major problem are manifold in any centre for the disabled. Discarded pieces of equipment fill cupboards and corners, and clutter up corridors. Sometimes they are discarded because they are specialised to the needs of a particular client who is no longer at the centre, but far more frequently they have been rejected as unsuitable for their intended purpose. Similarly, there must be few families with a disabled member who have not purchased quite expensive devices which have quickly proved to be useless.

Even where a piece of equipment is in use, it is often difficult to use, clumsy to transport, unreliable, or cosmetically unsatisfactory. A client may well struggle on in such a situation for years, feeling that the equipment is probably all that can be provided, or that at least they are used to it; in the present situation they may well be right. (Fortunately in recent years users are becoming more vocal, and on occasion are actually listened to.)

A critical examination of the multiplicity of small journals for the disabled and elderly is also thought-provoking. If it is realised that the devices featured are the most successful in the field, it has to be admitted that some of them are still less than suitable for their intended purpose. The unsuccessful devices of

course never appear. Moreover, it is clear that many of the featured devices are replicas of similar products made elsewhere, always on a very small scale.

Grant applications for funding by public bodies and private benefactions are also symptomatic. The proposals put forward are frequently over-ambitious; but many of them are also poorly thought through. The worst variety describe "good ideas" which have never received any preliminary trials, have been put forward by applicants unfamiliar with the problems to be solved, and which have not been developed in close collaboration with therapists and the clients themselves. The grant applicants usually (but not always) have the highest motives, but this is all the more reason to scrutinise their applications rigorously.

These problems are not unique to biomedical engineering; a good deal of industrial instrumentation is less than satisfactory. But a comparison may be made between bioengineering for the disabled and engineering for Third World countries; in each case the keyword is APPROPRIATE engineering.

TYPICAL PROBLEMS

A device may be inappropriate for several reasons. It may be

(i) unsuited to the client's requirements

(ii) badly designed or constructed, and therefore unreliable

(iii) too clumsy

(iv) too expensive.

(i) This is a very common problem. For example, a powered wheelchair controlled by a joystick must be at all times under the control of the occupant. Obviously a joystick which requires more force to operate than the client can provide is useless; but a joystick which is too loose will be operated by sudden jerks of the chair feeding back through the user's arm. Less obviously, some programming of acceleration is desirable, to avoid jerks and to allow inching up to a bench or table.

Voice controlled wheelchairs are quite feasible technically, but are rejected by many young adult quadriplegics on the basis that riding in a chair is bad enough, but when you are seen to be talking to the chair too, that is the end!

Control of devices by eye-blinking has been suggested to me many times; I have usually suggested to the proponents that they write out a list of commands, and then try them themselves in front of a mirror for half an hour.

A classical example of a device unsuited to the user's requirements was installed some time ago in the disabled toilets of an international airport. It consisted of an overhead rope trapeze to allow the user to swing from a wheelchair on to a toilet. Having got there, if the user released the trapeze, it promptly swung back out of reach. These devices have since, happily, been removed, and suitable fixed handgrips installed instead.

(ii) Unreliable devices are all too common. They may be unreliable due to bad design, bad construction or bad maintenance.

Bad design can be in poor mechanical engineering (e.g., non-rigid frames, unsuitable choice of materials, welds or size of frame members) or poor electrical engineering (e.g., unsuitable choice of motors or power sources, inefficient or unreliable controllers). For an example of bad design, consider how many devices use castors, and how many of these castors "dither" when the device is used. A fair answer would be "Most of them". Yet the design of castors is well understood and described in engineering literature.

Again, many wheelchairs are designed with the footplates well in front of the front wheels, usually in an attempt to minimise wheelbase length for ease of transport. If the user is paraplegic, and falls out of the chair, his (or her) only hope of recovery without assistance is to right the chair and attempt to hoist him (or her) self back using the footplates as an intermediate seat. Unless the front wheels are castors and are set in front of the footplates recovery is impossible.

Bad construction is not infrequent; in mechanical devices it is often in the form of poor welds or brazed joints covered with paint, or sharp edges of metal left where a hand can find them. Poor soldering in electrical circuits in another fruitful cause of failure, but there are many others.

Bad maintenance is very common, ranging from failure to lubricate moving parts to failure of battery maintenance, or frayed wiring and loose switches and knobs. The move to independent living has not simplified this problem, despite its other advantages.

(iii) Clumsy equipment is very common. It often arises simply by tradition: "this is how we have always done it". It can also be due to the use of unsuitable materials, for reasons of economy, (e.g., wood instead of light alloy). However caused, it certainly represents VERY poor engineering. Typical examples are again wheelchairs, especially those that must be transported regularly. It is very difficult to produce a good neat powered transportable chair. Modern designs are a great improvement in this respect.

I have seen a number of attempts to produce a stair-climbing wheelchair. These fall into two classes; some have the climbing gear integral with the chair, and retractible; others have the chair running on to a separate climbing undercarriage. In either case, manual operation is necessarily slow, since the continuous (aerobic) power capable of being developed, even by the most muscular paraplegic, is quite small. Motor-powered devices still are slow, and of course far heavier. I would have to give a verdict of "Too clumsy" to any I have examined.

(iv) Much equipment is excessively expensive in terms of what it can achieve, or indeed in terms of the funds available to purchase it. In Australia, it is not impossible to raise from local service groups or public grants a sum of two or three thousand dollars for a device to aid an individual client. Any more is not feasible, except in very special circumstances. I will be discussing cost minimisation below.

DEVELOPING AN APPROPRIATE DEVICE

The design of an appropriate aid for the disabled or elderly may begin in several ways. The one least likely to succeed is for a person with technical training but no previous contact with the problems of the disabled to invent a solution to a problem which he thinks exists. (I have no hesitation in saying "he" in this context.) He may be a retired engineer or scientist, or he may be a member of a department of a tertiary institution, looking for a grant or a problem for a graduate student. It is not easy to advise such individuals in a fruitful way; often they actively reject any advice at all, no matter how tactfully it is offered. In one or two cases I have encountered, the experimenter found association with the disabled, and even with standard textbooks on physiology and anatomy, acutely distasteful. Of course, not all academics in departments of science or engineering are like this, but I have to admit that some are.

A more hopeful case is the person who, like the previous one, has technical training but no prior contact with the disabled, and who is brought up against a major disability among his friends, his family, or even in himself. He is usually prepared to learn about the parameters of the problem, to read some technical material, and to test his ideas out on his client. His problem is that he has no background in general physiology (do the attachments of his prosthesis, for example, occlude the venous return from a limb?) One of my colleagues was visited by an engineer who had taken off his left arm below the elbow in a guillotine. He could see movement in all the remaining tendons, and found it very hard to accept that it was not possible to attach cables to them, bring them through the stump of the amputation, and use them to operate a prosthesis directly.

However, amateurs working with disabled clients have scored many successes, though often they did not realise the amount of work and time needed to produce a successful outcome. They deserve every encouragement from the professionals, so long as they will accept advice.

The best designs arise when there is full communication between bioengineer, doctor, therapist and client. If you as an engineer wish to work for a French firm in Quebec, you would be well advised to become fluent in French. Similarly if you as an engineer wish to work in the biomedical field, you must learn medical terminology, the medical way of thinking about a problem, and as much of physiology and anatomy as you can (biochemistry, microbiology and pathology could be useful too). Your medical and paramedical colleagues and your clients are not going to learn engineering to facilitate communication with you. Also, you must learn the human side of medicine, and particularly how to relate to your clients. In these circumstances a design need may be identified by the bioengineer, the therapist or teacher, the medical staff, or the client. Only when quite detailed discussions have been held should a tentative design emerge, and any abrogation of responsibility by any member of the team is certain to result in an unsatisfactory outcome. When a problem is approached in this way, a successful outcome is not necessarily assured, but its likelihood is maximised.

CLINICAL TRIALS

The hand-crafting of an aid to the disabled is fine in the experimental stage, where the first units are undergoing clinical trials. A tertiary institution, hospital or centre workshop if properly organised can turn out reliable and functional units, which can then be sent for critical evaluation in one or more appropriate centres, and their faults corrected in the light of experience. After this has been done, a decision must be made. It is a painless process to spend time and money (usually amounting to tens of thousands of dollars if overheads are properly costed) to produce a unit for two or three clients in the host institution, and then perhaps to publish the design. But if the design has wider applicability as an aid to the disabled or elderly, this procedure is both economically and morally WRONG. Either the device will be re-invented and redeveloped in dozens of different centres, or it will not be available to others who need it. Do not suppose I am being unduly critical of the originators of the device. Their terms of reference, their skills, and their inclinations do not cover production and marketing, nor should they; but nor should their work be lost. What can be done?

PRODUCTION AND MARKETING

The first reaction of the originators of a device which has proved acceptable during clinical trials is to look for a company to manufacture it. If the originators have had no prior experience in this direction, they are likely to believe that manufacturers are just waiting for opportunities such as they are offering. This is unfortunately not the case at all. To examine the problem, place yourself in the manufacturer's position.

Firstly, he must determine whether there is a market for the device, and if so its extent; some sort of market survey is the first step. This need not be an elaborate or expensive survey, and the originators of the device can be of great help, providing that they temper their enthusiasm with realism. For example, most countries have an adequate data base on the occurrence and distribution of most disabilities. A crucial point here is whether the device will occupy a "niche in the market", or whether it will be in direct competition with existing devices. In the latter case, it must offer substantial advantages in function or cost.

It is entirely possible that the device is excellent in concept, and fills a real need, but has only a very limited market. I recall a device for corneal grafting; it cut out the patient's old cornea in a neat circle, cut out the cornea to be transplanted in a neat circle, and the transfer was then simple. But the market in Australia was for perhaps six of these devices, and the world market was limited in proportion. No ordinary manufacture could touch a device like this; the cost of tooling up alone would be prohibitive. A second situation is where the device has a potential market but is novel; a market then has to be created by pure salesmanship.

One method which is not unknown is to manufacture a non-functional "mockup" of the device, photograph it (often in conjunction with a photographic model), produce a glossy brochure giving specifications, distribute it widely, and await orders. If enough orders are received, the actual design is then commenced, perhaps nine months or a year later. (Moral: if you are a customer, NEVER order anything on the basis of a glossy brochure. Insist on seeing a working example, or talk to someone who is using one.)

Once a manufacturer has decided to produce your device a great deal of tolerance on both his and your part is called for. He will almost certainly need to redesign from the beginning, to suit his production techniques and to adopt the device to what he perceives the market needs. This alway involves compromise. You invented it, but he is laying out capital to manufacture it. How firmly

you should insist on any particular feature depends a lot on how important it is to the function of the finished product, and how much added cost will be involved by its inclusion.

Once drafting and tooling up for production are complete, it is usual to carry out a pilot run; the units so produced can then undergo clinical trials (hopefully quick ones).

Pricing of the finished article is always a surprise to the inventor, since, unlike the manufacturer, he does not have to consider the hidden costs such as power, lighting, interest on capital investment, loadings on salaries, profits, taxes and a host of other items. A retail price three times the cost at the end of the production line is not unusual. If this cost is prohibitive, production is not possible. It must be remembered that production always involves a negative cash flow; once production is started, money keeps on flowing out, month by month, until eventually sales have reached a point where income equals outflow, exceeds it, and eventually has compensated for all the original outlay. Only then is there any profit. This is obvious once it is pointed out to the inventor, but it needs to be said.

The requirement for an initial cash investment is the key to understanding the problem of getting an invention into commercial production. The magnitude of this investment depends both on the complexity of the invention and the size of the company involved in production. A large company could not touch anything that did not promise eventual sales amounting to hundreds of thousands or millions of dollars a year; a small company may have neither the financial stability nor the resources to carry through manufacture at all.

I have been involved in the transfer from research into production of two aids to the disabled, and have developed others which in the event turned out to be simply not commercially viable. Naturally, I will concentrate on the two successes!

The first is the multi-electrode implanted hearing prosthesis for the totally deaf, now manufactured by Cochlear Pty Ltd in Sydney. Cochlear is part of a very large Australian biomedical engineering group. It would need to be, because the final hearing aid is a very complex piece of electronics, and its development has involved many millions of dollars of investment, over more than ten years. The concept is due to Professor Graeme Clark, head of the Department of Otolaryngology in the University of Melbourne (2). We decided initially that it should provide an array of stimulatiing electrodes to be inserted into the patient's inner ear, and that it should be both powered and driven by signals transmitted

inductively through the skin. The first step was to develop the coding strategy; this was done as a doctoral project by Dr. Ian Forster (3), (4) in my laboratory in the Department of Electrical Engineering, University of Melbourne. The resulting model worked well, but no attempt at miniaturisation was made; the receiver occupied a 30 cm cube.

To miniaturise the system and further develop the encoding, Professor Clark set up a small team of audiologists and engineers in the Department of Otolaryngology. Even at this point funding with research money was always precarious, since the project was far bigger than usual funding allowed. Eventually a small number of units was produced and implanted into patients; they were hand-crafted, and relatively clumsy by modern standards, but they worked.

At this point it was time for transition to commercial manufacture. This clearly required a very large amount of capital, and financial bodies willing to invest "risk capital" of this order on a device which did not yet exist commercially were impossible to find. Eventually an Australian government scheme to finance high technology projects classed as being in the public interest allowed the project to start, and its outcome has been a happy one.(6)

The second device was much simpler (5). It is FRED, standing for "Friendly Educational Device". It consists of a microprocessor unit, programmed by a "smart" credit card memory, controlled by joysticks or other input devices appropriate to those clients who could never use a keyboard, and generating a colour television display with sound effects. An immediate reaction to this description is that many centres have produced similar devices, using commercial home computer systems. So they have; so why aren't these systems incorporated into training for the disabled everywhere?

Fundamentally, such systems are too expensive, are poorly supported by software, training manuals and service, and do not have input devices suited to the abilities of the users. Our objective was to produce a simple, compact, dedicated system to drive a domestic television set, together with the necessary ancillary devices, and software to provide for communication, ordinary teaching, therapy exercises, biofeedback, and even entertainment.

At this stage, eleven years after starting the project, FRED is just coming into commercial production, by Micro Byte Systems Pty Ltd of Adelaide. The prototype development of six units for clinical trials and their support occupied five years, about $100,000 of research money, and the work of myself, several research fellows, a programmer, and several graduate students. Getting

FRED into commercial production has involved a government public interest grant of $300,000 and an abortive commercial development which led to the production of ten prototypes before the original manufacturer relinquished production.

In summary, for production of an invention in small quantities (say 50 per year) a small but reliable manufacturer is needed, together with enough capital to set up (say $250,000). For larger production and production for export, the capital required is at least an order greater. It is not at all easy, but it can be done.

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